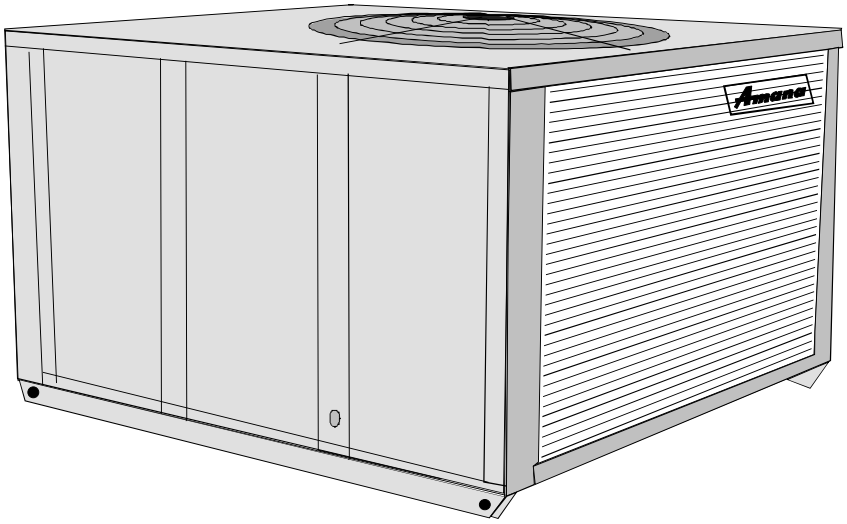
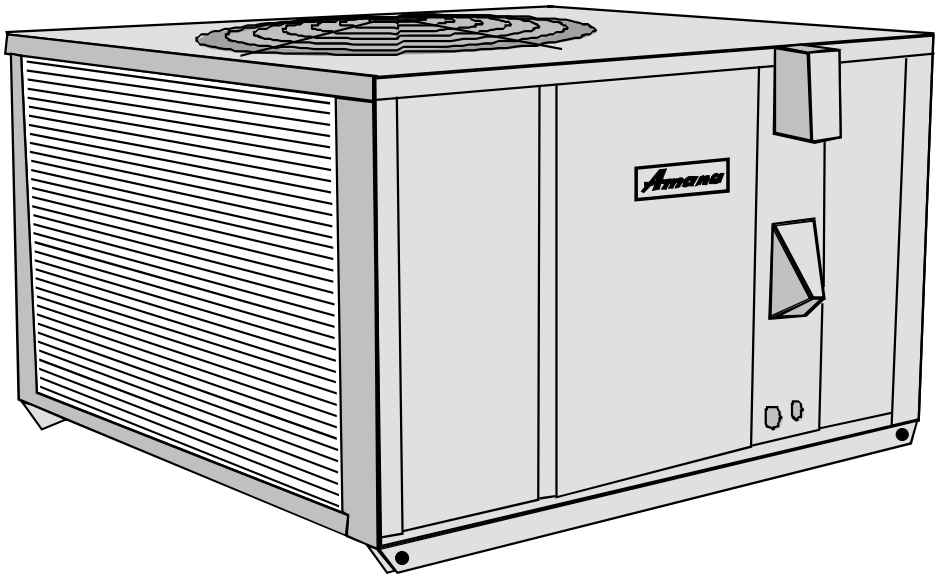
Service Instructions

Model and Manufacturing numbers listed on page 6

PHB**C, PHD**C PACKAGE HEAT PUMPS PGA**C, PGB**C, PGD**C PACKAGE GAS & PCC**C PACKAGE COOLERS





This manual is to be used by qualified HVAC technicians only. Amana does not assume any responsibility for property damage or personal injury for improper service procedures done by an unqualified person.

RS6300003
February 2000

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IMPORTANT INFORMATION

Pride and workmanship go into every product to provide our customers with quality products. It is possible, however, that during its lifetime a product may require service. Products should be serviced only by a qualified service technician who is familiar with the safety procedures required in the repair and who is equipped with the proper tools, parts, testing instruments and the appropriate service manual. **REVIEW ALL SERVICE INFORMATION IN THE APPROPRIATE SERVICE MANUAL BEFORE BEGINNING REPAIRS.**

IMPORTANT NOTICES

⚠ WARNING **IF REPAIRS ARE ATTEMPTED BY UNQUALIFIED PERSONS, DANGEROUS CONDITIONS (SUCH AS EXPOSURE TO ELECTRICAL SHOCK) MAY RESULT. THIS MAY CAUSE SERIOUS INJURY OR DEATH.**

⚠ CAUTION **AMANA WILL NOT BE RESPONSIBLE FOR ANY INJURY OR PROPERTY DAMAGE ARISING FROM IMPROPER SERVICE OR SERVICE PROCEDURES. IF YOU PERFORM SERVICE ON YOUR OWN PRODUCT, YOU ASSUME RESPONSIBILITY FOR ANY PERSONAL INJURY OR PROPERTY DAMAGE WHICH MAY RESULT.**

To locate an authorized servicer, please consult your telephone book or the dealer from whom you purchased this product. For further assistance, please contact:

CONSUMER AFFAIRS DEPT.	**OR**	1-319-622-5511
AMANA REFRIGERATION, INC.	**CALL**	and ask for
AMANA, IOWA 52204		Consumer Affairs

If outside the United States contact:

AMANA REFRIGERATION, INC.
ATTN: INTERNATIONAL DIVISION
AMANA, IOWA 52204, USA
Telephone: (319) 622-5511
Facsimile: (319) 622-2180

RECOGNIZE SAFETY SYMBOLS, WORDS AND LABELS

⚠ DANGER **DANGER -** Immediate hazards which **WILL** result in severe personal injury or death.

⚠ WARNING **WARNING -** Hazards or unsafe practices which **COULD** result in severe personal injury or death.

⚠ CAUTION **CAUTION -** Hazards or unsafe practices which **COULD** result in minor personal injury or product or property damage.

IMPORTANT INFORMATION

⚠ WARNING

SYSTEM CONTAMINANTS, IMPROPER SERVICE PROCEDURE AND/OR PHYSICAL ABUSE AFFECTING HERMETIC COMPRESSOR ELECTRICAL TERMINALS MAY CAUSE DANGEROUS SYSTEM VENTING.

System contaminants, improper Service Procedure and/or physical abuse affecting hermetic compressor electrical terminals may cause dangerous system venting.

The successful development of hermetically sealed refrigeration compressors has completely sealed the compressor's moving parts and electric motor inside a common housing, minimizing refrigerant leaks and the hazards sometimes associated with moving belts, pulleys, or couplings.

Fundamental to the design of hermetic compressors is a method whereby electrical current is transmitted to the compressor motor through terminal conductors which pass through the compressor housing wall. These terminals are sealed in a dielectric material which insulates them from the housing and maintains the pressure tight integrity of the hermetic compressor. The terminals and their dielectric embedment are strongly constructed, but are vulnerable to careless compressor installation or maintenance procedures and equally vulnerable to internal electrical short circuits caused by excessive system contaminants.

In either of these instances, an electrical short between the terminal and the compressor housing may result in the loss of integrity between the terminal and its dielectric embedment. This loss may cause the terminals to be expelled, thereby venting the vaporous and liquid contents of the compressor housing and system.

A venting compressor terminal normally presents no danger to anyone providing the terminal protective cover is properly in place.

If, however, the terminal protective cover is not properly in place, a venting terminal may discharge a combination of

(a) hot lubricating oil and refrigerant

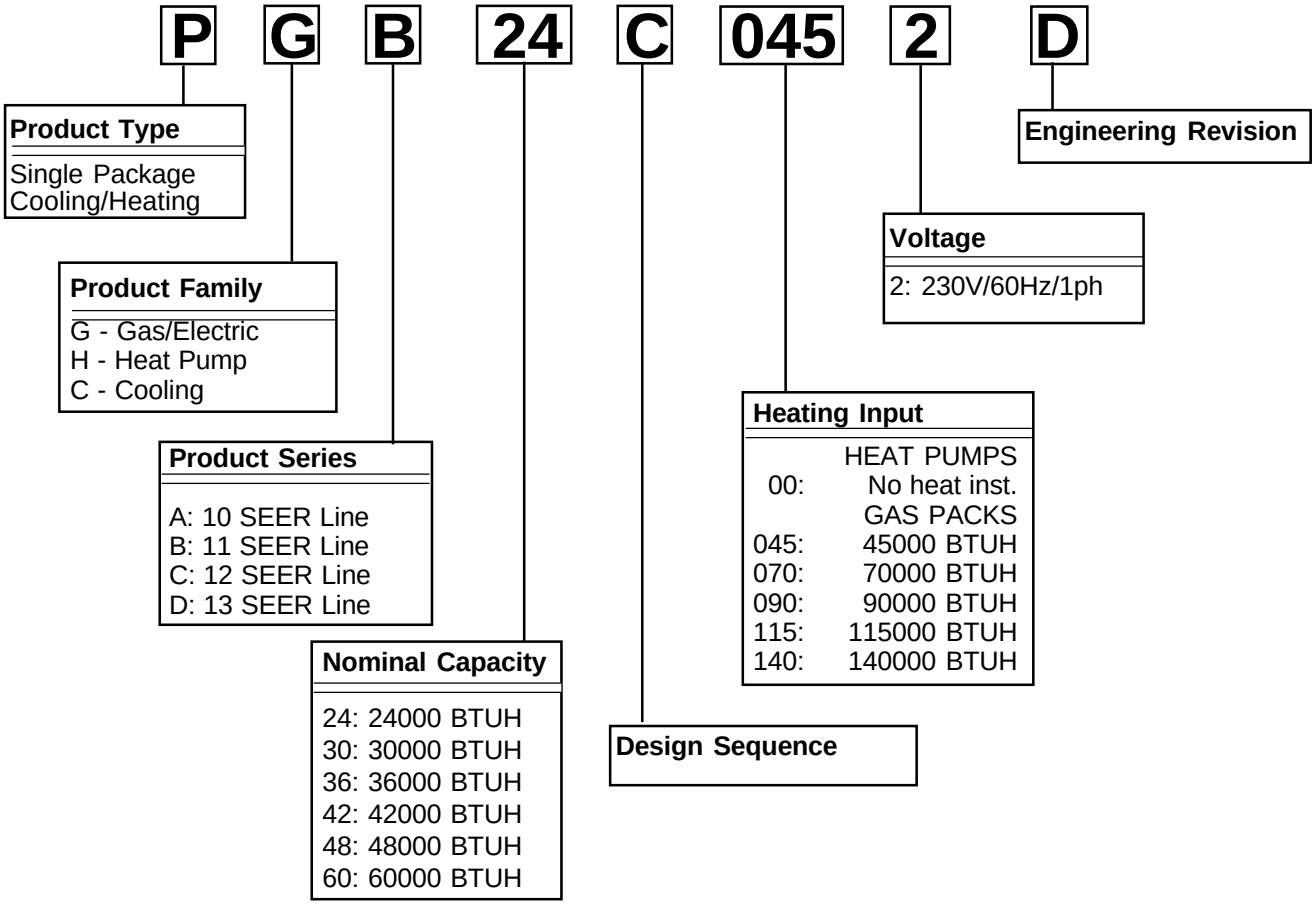
(b) flammable mixture (if system is contaminated with air)

in a stream of spray which may be dangerous to anyone in the vicinity. Death or serious bodily injury could occur.

Under no circumstances is a hermetic compressor to be electrically energized and/or operated without having the terminal protective cover properly in place.

See Service Section S-17 for proper servicing.

PRODUCT IDENTIFICATION



PRODUCT IDENTIFICATION

Model #	Manufacturing #	Description
PGA60C0902D PGA60C1152D	P1217301C-P1217302C	**P**ackage **G**as (**A**) 10 Seer gas/electric units. New chassis design with smaller footprint. PGA models have stronger blower performance for down shot applications.
PGA60C0902D PGA60C1152D	P1220301C-1220302C	**P**ackage **G**as (**A**) 10 Seer gas/electric units. Changed from 26" fan blade to 22" fan blade to improve operating sound. PGA models have stronger blower performance for down shot applications.
PGA60C0902E PGA60C1152E	P1231901C-P1231902C	**P**ackage **G**as (**A**) 10 Seer gas/electric units. Changed from Smart Valve system to "DSI" direct spark ignition systems. PGA models have stronger blower performance for down shot applications.
PGB**C***2D	P1213601C-P1213608C P1217201C-P1217207C	**P**ackage **G**as (**B**) 11 Seer gas/electric units. New chassis design with smaller footprint.
PGB**C***2D	P1220201C-P1220207C P1222201C-P1222208C	**P**ackage **G**as (**B**) 11 Seer gas/electric units. Changed from 26" fan blade to 22" fan blade to improve operating sound.
PGB**C***2E	P1231701C-P1231708C P1231801C-P1231807C	**P**ackage **G**as (**B**) 11 Seer gas/electric units. Changed from Smart Valve system to "DSI" direct spark ignition systems.
PGD**C***2D	P1204301C-P1204308C	**P**ackage **G**as (**D**) 13 Seer gas/electric units. New chassis design with smaller footprint.
PGD**C***2D	P1222301C-P1222308C P1231402C-P1231407C	**P**ackage **G**as (**D**) 13 Seer gas/electric units. Changed from 26" fan blade to 22" fan blade to improve operating sound.
PGD**C***2E	P1232001C-P1232008C P1232101C-P1232107C	**P**ackage **G**as (**D**) 13 Seer gas/electric units. Changed from Smart Valve system to "DSI" direct spark ignition systems.
PHB**C02D	P1214402C-P1214404C	**P**ackage **H**eat Pump (**B**) 11 Seer heat pump units. New chassis design with smaller footprint.
PHB**C02E	P1204501C-P1204503C	**P**ackage **H**eat Pump (**B**) 11 Seer heat pump units. New chassis design with smaller footprint. Improved heating capacity
PHB**C02E	P1220101C-P1220106C	**P**ackage **H**eat Pump (**B**) 11 Seer heat pump units. Changed from 26" fan blade to 22" fan blade to improve operating sound.
PHB**CC2E	P1228101C-P1228103C	**P**ackage **H**eat Pump (**B**) 11 Seer heat pump units. New chassis design with smaller footprint. With 10 K.W. factory installed heat strips.
PHD**C02E	P1224301C-P1224305C	**P**ackage **H**eat Pump (**D**) 13 Seer heat pump units. New chassis design with smaller footprint.
PHD**CC2E	P1228201C-P1228203C	**P**ackage **H**eat Pump (**D**) 13 Seer heat pump units. New chassis design with smaller footprint. With 10 K.W. factory installed heat strips.
PCC**C02E	P1231101C-P1231106C	**P**ackage **C**ooling (**D**) 12 Seer electric heat electric cooling units. New chassis design with smaller footprint.
Accessories		
PHCB**C1	P1219401C-P1219406C	**P**ackage **H**eat kit with **C**ircuit **B**reakers. Electric heat kits include breakers for electric heat only.
SPK**A	P1221701C-P1221706C	**S**ingle **P**oint power connection **K**it. Kit allows for one circuit to provide power supply for package heat pumps (PHB/PHD**C) and coolers (PCC**C). Kit includes circuit breaker for compressor.
PRC06A1 PRC07A1 PRC07A1	P1219801C-P1219803C	**P**ackage **R**oof **C**urb Kit. Accessory roof curb for roof top/down discharge installations. PRC06A1 is designed for package heat pumps and coolers. PRC07A1 is designed for package gas units. PRC07A1 is a combo curb and will adapt to either footprint.
PDTROU4A PDTROU6A	P9850603C-P9850604C	**P**ackage **D**uct **TR**ansition **O**ver-**U**nder kit. Transition converts side by side to over-under duct connections. Early model Amana units (EPCG, EPHO, EP, and PHK) had over-under duct connections.

PRODUCT IDENTIFICATION

Additional Amana accessories, as described below, can be purchased to fit specific application needs. Accessories can be ordered by the following part numbers and each accessory includes its own separate instructions.

ACCESSORY	PART NUMBER	DESCRIPTION
Duct Transition Round	RSDK01A (24-60)	Converts existing round duct connections to rectangular. Used to install the horizontal duct cover kit on **heat pump units**.
Duct Transition Over/Under	PDTR0U4A (Sm Chassis) PDTR0U6A (LG Chassis)	Converts existing side by side duct connections to over & under ductwork. (For replacement purposes). Some Amana preceding units had over & under ductwork. For use on **all Amana Package Units.**
Roof Curbs	PRC06A1 PRC07A1 PRC08A1	Roof top mounting/support system for package units. Must be used when unit is installed in downflow applications. PRC06A fits **Package heat pump and coolers**. PRC07A1 fits Package gas/electric units. PRC08A1 is a combo roof curb adaptable to either footprint.
Horizontal Duct Cover Kits	CHK001A CHK002A CHK601A (6 PACK)	Blocks off horizontal discharge. Used for downflow applications. For use on **all Amana Package Units**.
50°F Compressor Lockout	LOK501A	Prevents mechanical cooling at ambients below 50°F. For use on **all Amana Package Units**.
Ambient Thermostat Kit	ATK01	This kit controls the staging of electric heat and allows supplemental heat to be energized only when a set outdoor temperature is reached. This will allow the system's heat output to more closely match the building's load. For use on **heat pump and cooling package units**.
Compressor Sound Blankets	CSB04A CSB07A CSB08A CSB09A	Compressor sound blankets reduce the ambient noise level of the package units. Used in installations where extra quite operation is desired. For use on **all Amana Package Units**.
Propane Gas Conversion Kit	LPTK07A LPTK09	Converts **package gas units** from natural gas to propane gas operation
Electric Heater Kits	PHCB05C1 PHCB10C1 PHCB15C1 PHCB20C1	4.8KW 1ph - 30 Amp Circuit Breaker 9.6KW 1ph - 50 Amp Circuit Breaker 14.4KW 1ph - 30 & 50 Amp Circuit Breakers 19.2KW 1ph - 2-50 Amp Circuit Breakers For use on **heat pump and cooling package units**.
Single Point Wiring Kits	SPK04A SPK05A SPK06A SPK07A SPK08A SPK09A	Single point wiring kit allows one electrical supply connection to power both heater kit and package unit. For use on **heat pump and cooling package units**.
THERMOSTATS	THSMEC1H2BA THSADC1H2BA THSMDC1H2BA THSMDC1H3BA 1213401 1213403 1213404 1213405 1213701 1214901 C5200607 M0380101 D6853512 D6853510 D9945801 D9807604	Manual changeover - 2 Stage Heat Auto changeover - 2 Stage Heat Manual changeover - 2 Stage Heat Auto changeover - 3 Stage Heat Electronic programmable - 1 Stage Heat, 1 Stage Cool Electronic non-programmable - 2 Stage Heat, 1 Stage Cool Electronic non-programmable - 2 Stage Heat, 1 Stage Cool Electronic programmable - 2 Stage Heat, 1 Stage Cool Electronic programmable - 1 Stage Heat, 1 Stage Cool Electronic programmable - 2 Stage Heat, 2 Stage Cool Manual changeover - 1 Stage Heat, 1 Stage Cool Manual changeover - 1 Stage Heat, 1 Stage Cool Auto changeover - 1 Stage Heat, 1 Stage Cool Auto changeover - 2 Stage Heat, 1 Stage Cool Manual changeover - 2 Stage Heat, 1 Stage Cool Electronic programmable - 1 Stage Heat, 1 Stage Cool

PRODUCT IDENTIFICATION

FOR YOUR SAFETY READ BEFORE OPERATING

WARNING If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

A. This appliance is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand.

B. **BEFORE OPERATING** smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch;
- Do not use any phone in your building.
- Immediately call your gas spplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas spplier, call the fire department.

C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

D. Do not use this appliance if any part has been underwater. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been underwater.

LIRE AVANT DE METTRE EN MARCHELIRE

AVERTISSEMENT: Ouiconque ne respcte pas `a la lettre les instructions dans le présent manuel risque de déclencher un incendie ou une explosion entraînant des dommages materiels, des lésions corporelles ou la perte de vies humaines.

A. Cet appareil est muni d'un dispositif d'allumage qui allume automatiqement la veilleuse. Ne pas tenter d'allumer la veillese manuellement.

B. AVANT DE LE FAIRE FONCTIONNER, renifler tout autour de l'appariel pour déceler une odeur de gaz. Renifler près du plancher, car certains gaz sont plus lourds que l'air et peuvent s'accmuler a niveau du sol.

QUE FAIRE S'IL Y A UNE ODEUR DE GAZ

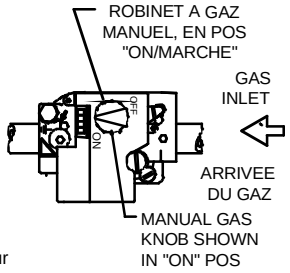
- Ne pas tenter d'allumer l'appariel.
- Ne toucher aucun interrupteur électrique; n'utiliser aucun téléphone dans le bâtiment.
- Appeler immédiatement le fournisseur de gaz en employant le téléphone dun voisin. Respecter à la lettre les instructions du fournisseur de gaz.
- Si personne ne repond, appeler le service des incendies.

C. Ne pousser ou tourner la manette d'admission du gaz qu'a la main; ne jamais emploer d'outil à cet effet. Si la manette reste coincée, ne pas tenter de la réparer; appeler un technicien qalifié. Quiconque tente de forcer la manette ou de la réparer peut déclencher une explosion ou un incendie.

D. Ne pas se servir de cet appareil s'il a été plongé dans l'eau, complètement ou en partie. Appeler un technicien qualifié pour inspecter l'appareil et remplacer tout partie du système de contrôle et toute commande qui ont été plongés dans l'eau.

OPERATING INSTRUCTIONS

1. STOP. Read the safety information above on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand.
5. Turn the gas control knob clockwise to "OFF" position. Do not force.
6. Wait five (5) mintes to clear ot any gas. Then smell for gas, including near the floor. If you then smell gas, STOP. Follow "B" in the safety information above on this label. if you don't smell gas, go to next step.
7. Turn gas control knob counterclockwise to "ON".
8. Replace access panel.
9. Turn on all electrical power to the appliance.
10. Set thermostat to desired setting.
11. If the appliance will not operate, follow the instrctions "To Turn Off Gas To Appliance" and call your service technician or gas company.



MISE EN MARCHE

1. **ARRÊTER!**. Lisez les instrcutions de sécurité sur la portion supérieure de cette étiquette.
2. Régler le thermostat à la température la plus basse.
3. Couper l'alimentation électrique de l'appareil.
4. Cet appareil est muni d'un dispositif d'allumage qui allume automatiquement la veilleuse. Ne pas tenter d'allumer la veilleuse manuellement.
5. Torner le robinet à gaz dans le sens des aiguilles d'une montre en position "OFF/ARRET" Ne pas forcer.
6. Attendre cinq (5) minutes pour laisser échapper tout le gaz. Renifler tout autour de l'appareil, y compris près du plancher, pour déceler une odeur de gaz. Si c'est le cas, ARRÊTER!. Passer à l'étape B des instructions de sécuurité sur la portion supérieure de cette étiquette. S'il n'y a pas d'odeur de gaz, passer à l'étape sulvante.
7. Tourner le robinet à gaz dans le sens inverse des aiguilles d'une montre en pos "ON/MARCHE".
8. Remettre en place le panneau d'accès.
9. Mettre l'appareil sous tension.
10. Régler le thermostat à la température désireé.
11. Si l'appareil ne se met pas en marche, suivre les instrcutions intitulées Comment couper l'admission de gaz de l'appareil et appeler un technicien qualifié ou le fournisseur de gaz.

TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electrical power to the appliance if service is to be performed.
3. Turn the gas control knob clockwise to "OFF" position. Do not force.
4. Replace control access panel.

POUR COUPER L'ADMISSION DE GAZ DE L'APPAREIL

1. Régler le thermostat à la température la plus basse.
2. Couper l'alimentation électrique de l'appareil s'il faut procéder à des opérations d'entretien.
3. Tourner le robinet à gaz dans le sens des aiguilles d'une montre en position "OFF/ARRET". Ne pas forcer.
4. Remettre en place le panneau d'accès.

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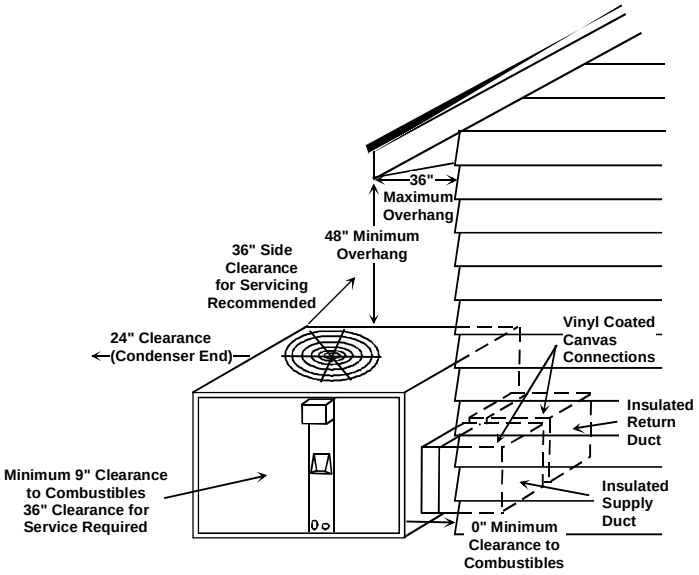
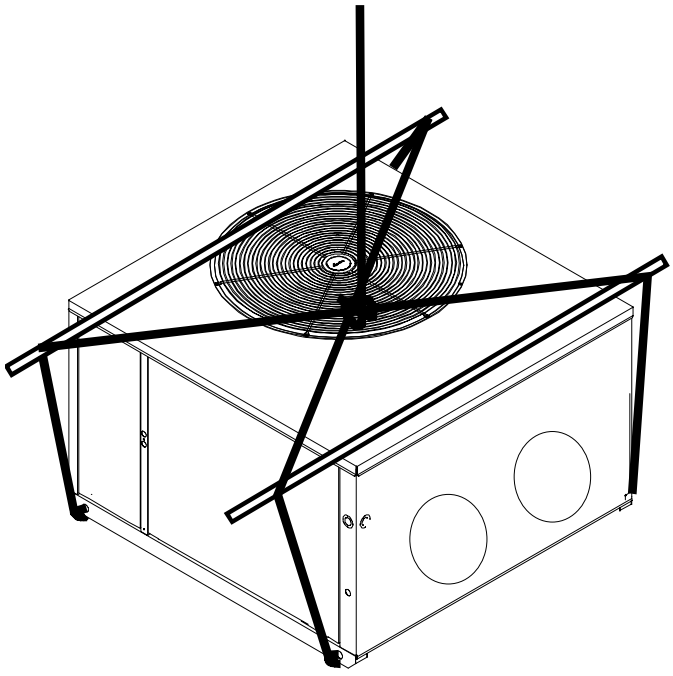
PRODUCT IDENTIFICATION



In installations where the unit is installed above ground level and not serviceable from the ground (Example: Roof Top installations) the installer must provide a service platform for the service person with rails or guards in accordance with local codes or ordinances or in their absence with the latest edition of the National Fuel Gas Code ANSIZ223.1.

NOTE: The flue outlet hood and air inlet hood (Package Gas Units) are packaged separately inside the unit and must be installed prior to operation.



NOTE: Units can also use roof curb (and platform for leveling, where necessary) to utilize bottom discharge.

⚠ WARNING

TO PREVENT POSSIBLE DAMAGE, THE UNIT SHOULD REMAIN IN AN UPRIGHT POSITION DURING ALL RIGGING AND MOVING OPERATIONS. TO FACILITATE LIFTING AND MOVING IF A CRANE IS USED, PLACE THE UNIT IN AN ADEQUATE CABLE SLIDE.

IMPORTANT: If using bottom discharge with roof curb, ductwork should be attached to the curb prior to installing the unit.

Refer to Roof curb Installation Instructions for proper curb installation. Curbing must be installed in compliance with the National Roofing Contractors Association Manual.

Lower unit carefully onto roof mounting curb. While rigging unit, center of gravity will cause condenser end to be lower than supply air end.

Amana Package Units are designed for outdoor installations only in either residential or light commercial applications.

The connecting ductwork (Supply and Return) can be connected for either horizontal or down discharge airflow. 140,000 BTU gas package units and PHB60C package units are not recommended for down discharge airflow applications. In the down discharge applications a matching Roof Curb is recommended

A return air filter must be installed behind the return air grille(s) or provision must be made for a filter in an accessible location within the return air duct. The minimum filter area should not be less than those sizes listed in the Specification Section. Under no circumstances should the unit be operated without return air filters.

A 3/4" tube is provided for removal of condensate water from the indoor coil. In order to provide proper condensate flow, a drain trap is built into the unit. (Do not reduce the drain line size).

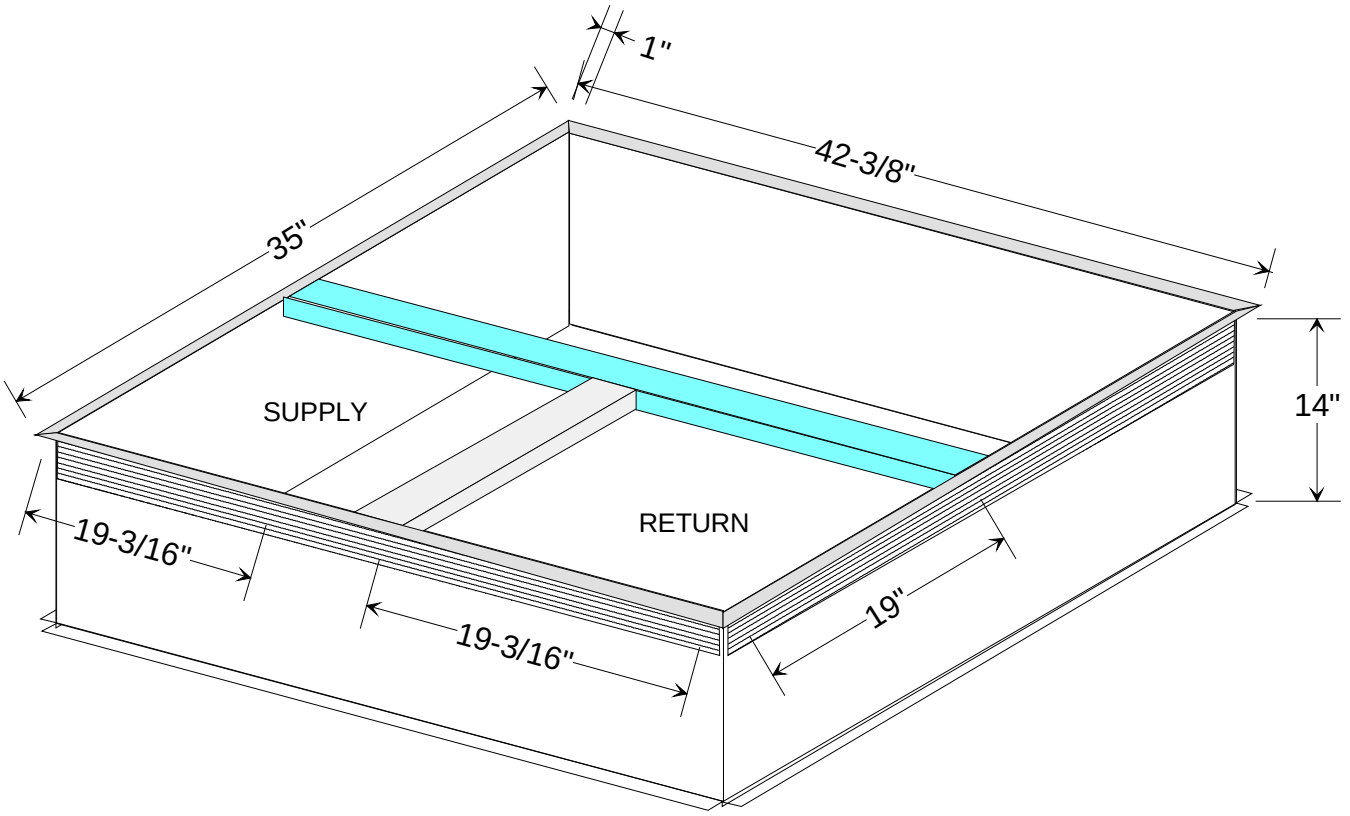
Refrigerant flow control is achieved by use of restrictor orifices or thermostatic expansion valves (TXV).

Package Heat Pump models use a combination of restrictor orifices and thermostatic expansion valves for refrigerant flow control.

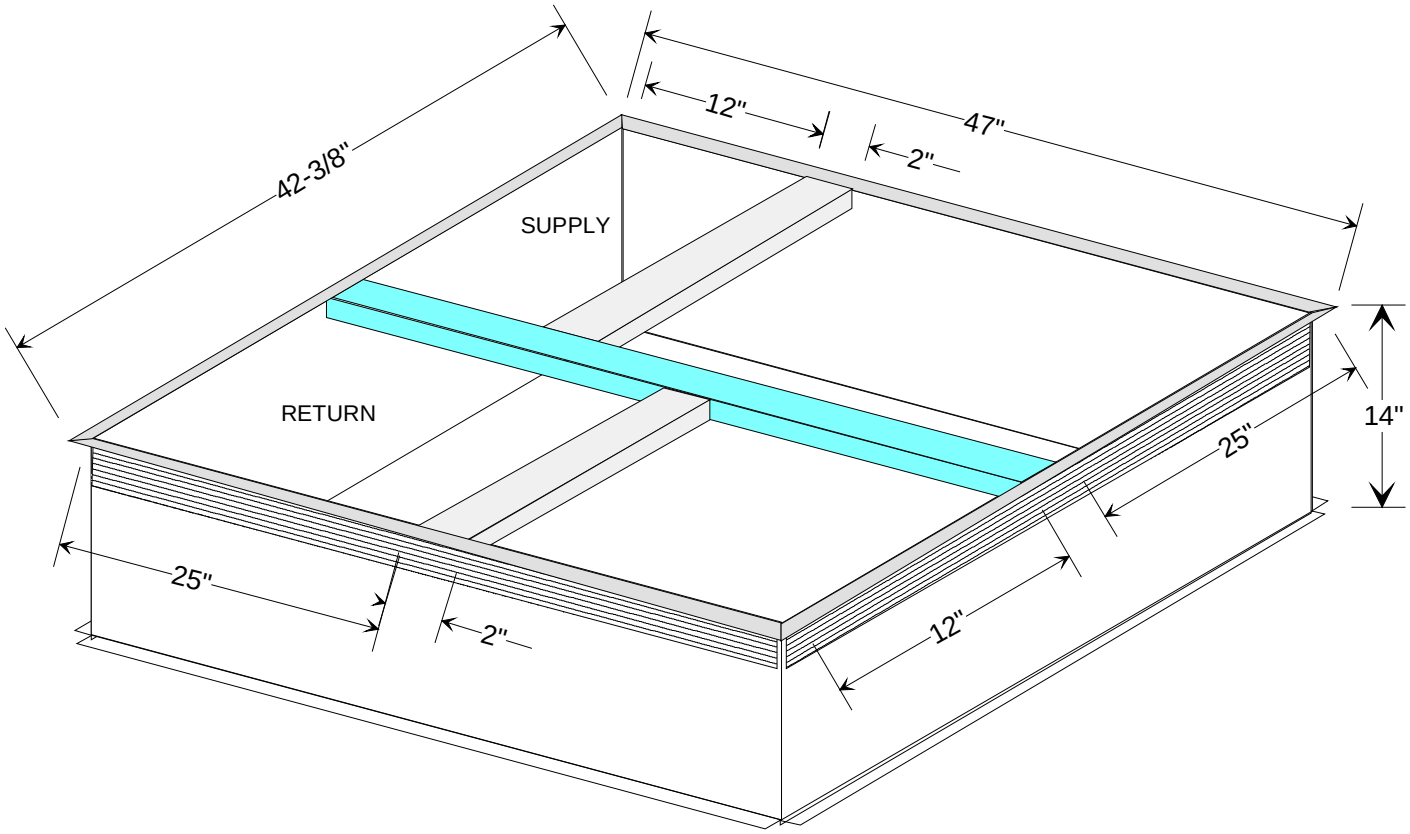
Some heat pump models also have a suction line accumulator installed between the reversing valve and the compressor. The object of the accumulator is to:

1. Provide a liquid refrigerant storage vessel during prolonged system off cycles.
2. Store excess liquid refrigerant not needed by the system while running.
3. Return to the compressor at a controlled rate oil and saturated vapor.
4. Retain stored excess refrigerant during a sudden system pressure fluctuation such as seen in defrost cycles.

PRODUCT IDENTIFICATION

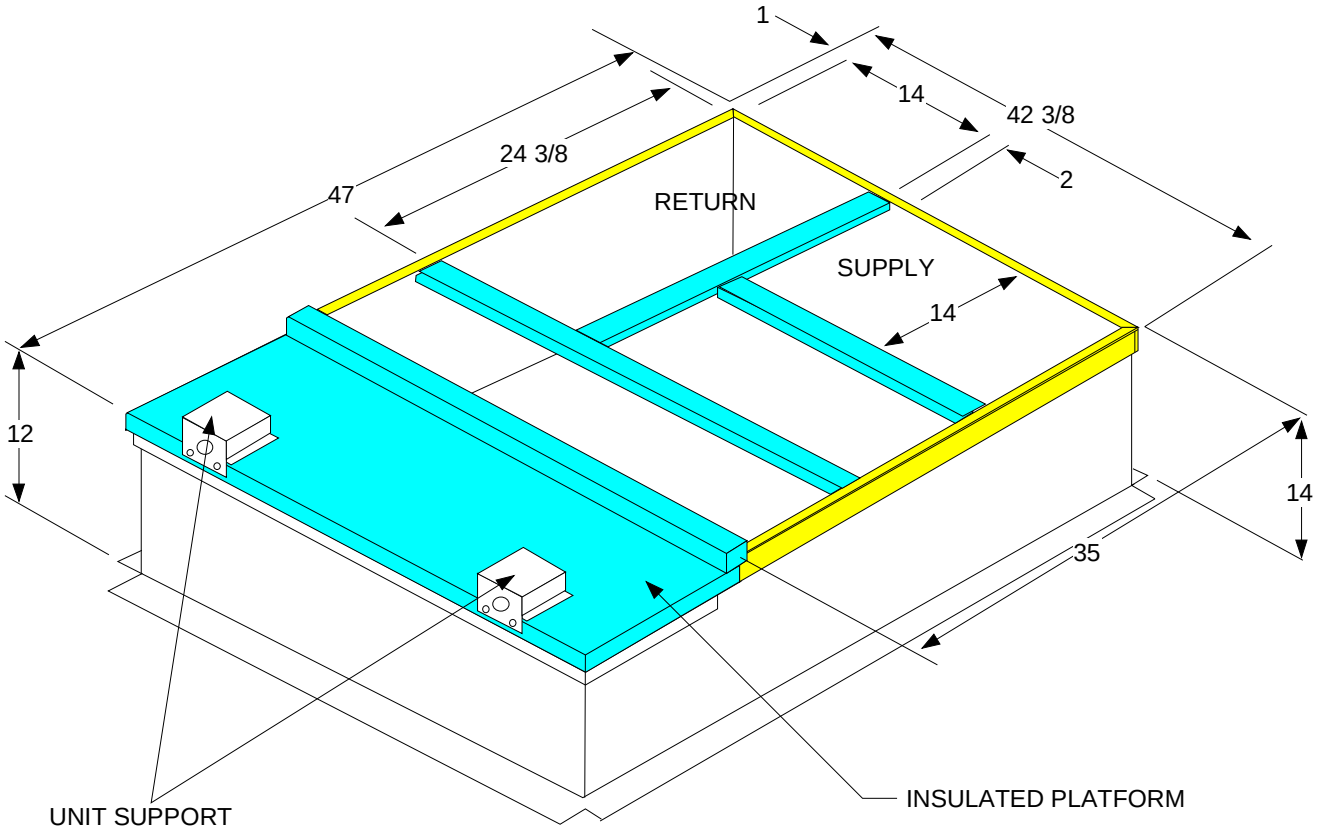


PRC06A1 ROOF CURB

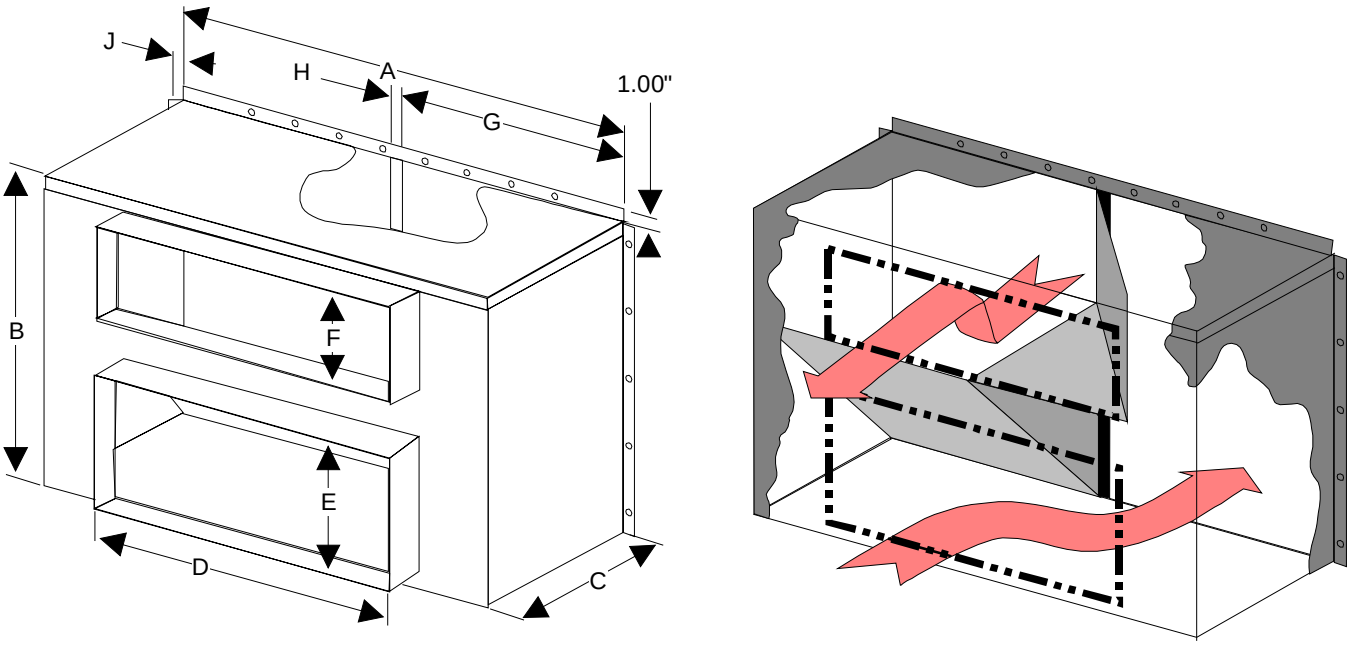


PRC07A1 ROOF CURB

PRODUCT IDENTIFICATION



PRC08A ROOF CURB



OVER/UNDER DUCT TRANSITION

AMANA MODEL	"A" DIM	"B" DIM	"C" DIM	"D" DIM	"E" DIM	"F" DIM	"G" DIM	"H" DIM	"J" DIM
PDTROU4A	42"	26 7/16"	12"	26 1/4"	15"	6 7/8"	20 11/16"	9/16"	9/16"
PDTROU6A	42"	32"	12"	39 1/2"	15"	10"	20 11/16"	1"	9/16"

Duct Transition Over/Under	PDTROU4A	Converts existing side by side duct connections to over/under ductwork. (For replacement purposes. Amana's preceding units had over/under ducts.)
	PDTROU6A	

PRODUCT DESIGN

The single phase units use permanent split capacitors (PSC) design compressors. Starting components are therefore not required. A low MFD run capacitor assists the compressor to start and remains in the circuit during operation.

The outdoor fan and indoor blower motors are single phase capacitor type motors.

Air for condensing (cooling cycle) or evaporation (heating cycle) is drawn through the outdoor coil by a propeller fan, and is discharged vertically out the top of the unit. The outdoor coil is designed for .0 static. No additional restriction (ductwork) shall be applied.

Conditioned air is drawn through the filter(s), field installed, across the coil and back into the conditioned space by the indoor blower.

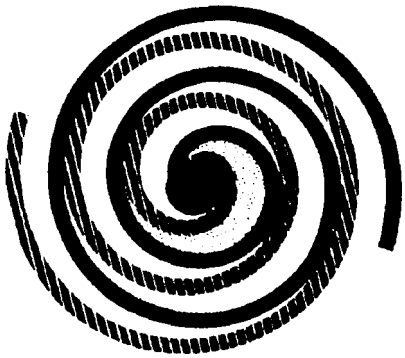
Package Heat Pump indoor sections are designed to accept optional components such as auxiliary electric heaters and circuit breakers. Provisions for these components have been made at time of manufacture.

Some models of PGA, PGB, & PGD series package units use the Compliant Scroll compressor, there are a number of design characteristics which are different from the traditional reciprocating compressor.

- Due to their design Scroll compressors are inherently more tolerant of liquid refrigerant. **NOTE**: Even though the compressor section of a Scroll compressor is more tolerant of liquid refrigerant, continued floodback or flooded start conditions may wash oil from the bearing surfaces causing premature bearing failure.
- These Scroll compressors use white oil which is compatible with 3GS. 3GS oil may be used if additional oil is required.
- Phase 1 Scroll compressors (ZR**K1 or ZR**K2), the compressor may run backwards (noisy operation) for 1 or 2 seconds at shutdown. This is normal and does not harm the compressor.
- Phase 2 Scroll compressors (ZR**K3). On shutdown, the scroll flanks will separate allowing the compressor to equalize internally within 0.4 seconds after shutdown.
- Operating pressures and amp draws may differ from standard reciprocating compressors. This information may be found in the "Cooling Performance Data" section.

The scroll is a simple compression concept first patented in 1905. A scroll is an involute spiral which, when matched with a mating scroll form as shown (next page), generates a series of crescent shaped gas pockets between the two members.

During compression, one scroll remains stationary (fixed scroll) while the other form (orbiting scroll) is allowed to orbit (but not rotate) around the first form.



As this motion occurs, the pockets between the two forms are slowly pushed to the center of the two scrolls while simultaneously being reduced in volume. When the pocket reaches the center of the scroll form, the gas, which is now at a high pressure, is discharged out of a port located at the center.

During compression, several pockets are being compressed simultaneously, resulting in a very smooth process. Both the suction process (outer portion of the scroll members) and the discharge process (inner portion) are continuous.

ELECTRICAL WIRING

⚠ WARNING

TO AVOID THE RISK OF ELECTRICAL SHOCK, WIRING TO THE UNIT MUST BE PROPERLY POLARIZED AND GROUNDED.

⚠ WARNING

TO AVOID ELECTRICAL SHOCK, INJURY OR DEATH, DISCONNECT ELECTRICAL POWER BEFORE CHANGING ANY ELECTRICAL WIRING.

The units are designed for operation on 60 hertz current and at voltages as shown on the rating plate. All internal wiring in the unit is complete. It is necessary to bring in the power supply to the pigtails or power block, which is located in the junction box or circuit breaker box assembly (or compressor contactor on package gas units) , as shown on the unit wiring diagram which is supplied with the unit. The 24V wiring must be connected between the unit control panel and the room thermostat.

LINE VOLTAGE WIRING

Power supply to the furnace must be N.E.C. Class 1, and must comply with all applicable codes. The furnace must be electrically grounded in accordance with the local codes

or, in their absence, with the latest edition of the National Electrical Code, ANSI/NFPA No. 70, or in Canada, Canadian Electrical Code, C22.1, Part 1. A fused disconnected must be provided and sized in accordance with the unit minimum circuit ampacity.

The best protection for the wiring is the smallest fuse or breaker which will hold the equipment on line during normal operation without nuisance trips. Such a device will provide maximum circuit protection.

DO NOT EXCEED THE MAXIMUM OVERCURRENT DEVICE SIZE SHOWN ON THE UNIT DATA PLATE.

All line voltage connections must be made through weather proof fittings. All exterior power supply and ground wiring must be in approved weather proof conduit. Low voltage wiring from the unit control panel to the thermostat requires coded cable. Unit knock out sizes are shown in the specification tables.

The unit transformer is connected for 230V operation. If the unit is to operate on 208V, reconnect the transformer primary lead and the induced draft blower leads as shown on the unit wiring diagram.

⚠ WARNING

TO AVOID THE RISK OF FIRE, PROPERTY DAMAGE OR PERSONAL INJURY, USE ONLY COPPER CONDUCTORS.

If it is necessary for the installer to supply additional line voltage wiring to the inside of the package unit, the wiring must comply with all local codes. This wiring must have a minimum temperature rating of 105°C. and must be routed away from the burner compartment. All line voltage splices must be made inside the furnace junction box.

GAS SUPPLY AND PIPING

Package Gas Units

⚠ CAUTION

THIS PACKAGE GAS UNIT IS FACTORY SET TO OPERATE ON NATURAL GAS AT THE ALTITUDES SHOWN ON THE RATING PLATE. IF OPERATION ON PROPANE IS REQUIRED, OBTAIN AND INSTALL THE PROPER CONVERSION KIT(S) BEFORE OPERATING THIS FURNACE. FAILURE TO DO SO MAY RESULT IN UNSATISFACTORY OPERATION AND OR EQUIPMENT DAMAGE.

The rating plate is stamped with the model number, type of gas, and gas input rating. Make sure the furnace is equipped to operate on the type of gas available.

INLET GAS PRESSURE	
NATURAL	MIN. 5.0", MAX. 10.0"
PROPANE	MIN. 11.0", MAX. 14.0"

Inlet Gas Pressure Must Not Exceed the Maximum Value Shown in the table Above.

The minimum supply pressure must not be varied downward because this could lead to unreliable ignition. In addition, gas input to the burners must not exceed the rated input shown on the rating plate. Overfiring of the furnace could result in premature heat exchanger failure.

GAS PIPING

⚠ CAUTION

TO AVOID POSSIBLE UNSATISFACTORY OPERATION OR EQUIPMENT DAMAGE DUE TO UNDERFIRING OF EQUIPMENT, DO NOT UNDERSIZE THE NATURAL GAS /PROPANE PIPING FROM THE METER/TANK TO THE FURNACE. WHEN SIZING A TRUNK LINE PER THE TABLES, INCLUDE ALL APPLIANCES ON THAT LINE THAT COULD BE OPERATED SIMULTANEOUSLY.

The gas pipe supplying the furnace must be properly sized based on the cubic feet per hour of gas flow required, specific gravity of the gas and length of the run. The gas line installation must comply with local codes, or in the absence of local codes, with the latest edition of the National Fuel Gas Code ANSI Z223.1.

NATURAL GAS CAPACITY OF PIPE IN CUBIC FEET OF GAS PER HOUR (CFH)

LENGTH OF PIPE IN FEET	NOMINAL BLACK PIPE SIZE				
	1/2"	3/4"	1"	1 1/4"	1 1/2"
10	132	278	520	1050	1600
20	92	190	350	730	1100
30	73	152	285	590	980
40	63	130	245	500	760
50	56	115	215	440	670
60	50	105	195	400	610
70	46	96	180	370	560
80	43	90	170	350	530
90	40	84	160	320	490
100	38	79	150	305	460

$$CFH = \frac{\text{BTUH FURNACE INPUT}}{\text{CALORIFIC VALUE OF GAS}}$$

CONNECTING THE GAS PIPING - NATURAL GAS

Refer to the figure 1 for the general layout of the furnace. The following rules apply:

1. Use black iron or steel pipe and fittings for the building piping.
2. Use pipe joint compound on male threads only. Pipe joint compound must be resistant to the action of the fuel used.

3. Use ground joint unions.
4. Install a drip leg to trap dirt and moisture before it can enter the gas valve. The drip leg must be a minimum of three inches long.
5. Use two pipe wrenches when making connection to the gas valve to keep it from turning.
6. Install a manual shut off valve. This shut off valve should be conveniently located within six (6) feet of the unit, and between the meter and unit.
7. Tighten all joints securely.
8. The furnace shall be connected to the building piping by one of the following:
   a. Rigid metallic pipe and fittings.
   b. Semirigid metallic tubing and metallic fittings. Aluminum alloy tubing shall not be used in exterior locations.
   c. Listed gas appliance connectors used in accordance with the terms of their listing that are completely in the same room as the equipment.
   d. In "b" and "c" above, the connector or tubing shall be installed so as to be protected against physical and thermal damage. Aluminum-alloy tubing and connectors shall be coated to protect against external corrosion where they are in contact with masonry, plaster, or insulation or are subject to repeated wettings by such liquids as water (except rain water), detergents, or sewage.

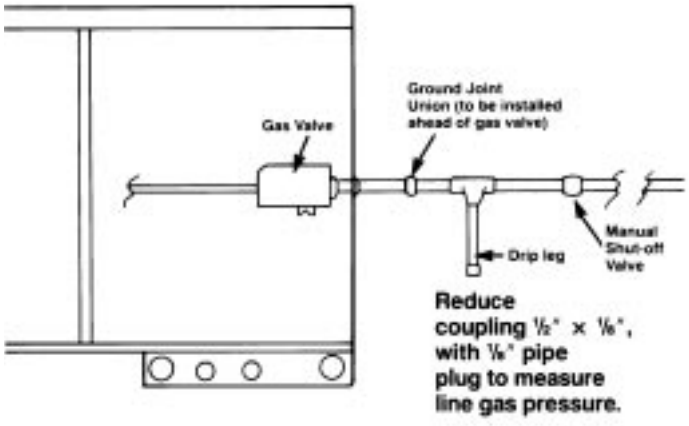

Gas Valve
Ground Joint Union (to be installed ahead of gas valve)
Drip leg
Manual Shut-off Valve
Reduce coupling ½" x ⅛", with ⅛" pipe plug to measure line gas pressure.

Figure 1

CHECKING THE GAS PIPING

⚠ CAUTION

TO AVOID THE POSSIBILITY OF PROPERTY DAMAGE, PERSONAL INJURY OR FIRE, THE FOLLOWING INSTRUCTIONS MUST BE PERFORMED REGARDING GAS CONNECTIONS AND PRESSURE TESTING.

The unit and its gas connections must be leak tested before placing in operation. Because of the danger of explosion or fire, never use a match or open flame to test for leaks. Never exceed specified pressure for testing. Higher pressure may damage the gas valve and cause overfiring which may result in heat exchanger failure.

This unit and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psig (3.48 kPa).

This unit must be isolated from the gas supply system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig (3.48 kPa).

TANKS AND PIPING - PROPANE UNITS

⚠ WARNING

PERSONAL INJURY HAZARD

IRON OXIDE (RUST) CAN REDUCE THE LEVEL OF ODORANT IN PROPANE GAS. A GAS DETECTING DEVICE IS THE ONLY RELIABLE METHOD TO DETECT A PROPANE GAS LEAK. CONTACT YOUR LOCAL PROPANE SUPPLIER ABOUT INSTALLING A GAS DETECTING WARNING DEVICE TO ALERT YOU IN THE EVENT THAT A GAS LEAK SHOULD DEVELOP.

FAILURE TO DETECT A PROPANE GAS LEAK COULD RESULT IN AN EXPLOSION OR FIRE WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR DEATH.

All propane gas equipment must conform to the safety standards of the National Board of Fire Underwriters (See NBFU Manual 58) or Natural Standards of Canada B149.2, Installation Code for Propane Gas Burning Appliances and Equipment.

For satisfactory operation, propane gas pressure must be 10 inch W.C. at the furnace manifold with all gas appliances in operation. Maintaining proper gas pressure depends on three main factors.

1. Vaporization rate, which depends on (a) temperature of the liquid, and (b) "wetted surface" area of the container or containers.
2. Proper pressure regulation. (Two-stage regulation is recommended from the standpoint of both cost and efficiency.)
3. Pressure drop in lines between regulators, and between second stage regulator and the appliance. Pipe size required will depend on length of pipe run and total load of all appliances.

Complete information regarding tank sizing for vaporization, recommended regulator settings, and pipe sizing is available from most regulator manufacturers and propane gas suppliers.

PRODUCT DESIGN

Propane is an excellent solvent, and special pipe dope must be used when assembling piping for this gas as it will quickly dissolve white lead or most standard commercial compounds. Shellac base compounds resistant to the actions of liquefied petroleum gases such as Gasolac, Stalactic, Clyde's or John Crane are satisfactory.

Refer to Figure 2 for typical propane gas installations.

TYPICAL PROPANE PIPING

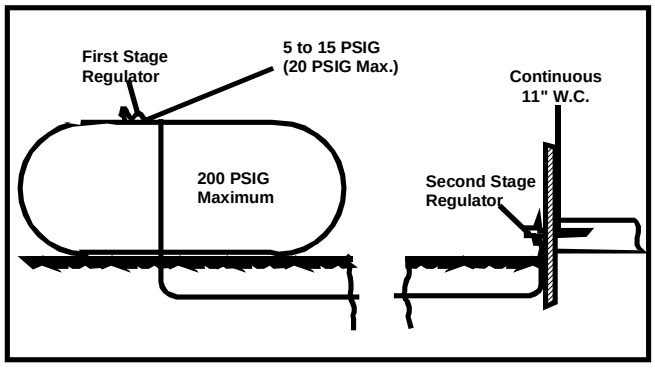


Figure 2

WARNING

IF YOUR PROPANE GAS FURNACE IS INSTALLED IN A BASEMENT, AN EXCAVATED AREA OR A CONFINED SPACE, WE STRONGLY RECOMMEND THAT YOU CONTACT YOUR PROPANE SUPPLIER ABOUT INSTALLING A WARNING DEVICE THAT WOULD ALERT YOU TO A GAS LEAK.

..... Propane gas is heavier than air and any leaking gas can settle in any low areas or confined spaces.

..... Propane gas odorant may fade, making the gas undetectable except with a warning device.

An undetected gas leak would create a danger of explosion or fire. If you suspect the presence of gas, follow the instructions on Page 8. Failure to do so could result in SERIOUS PERSONAL INJURY OR DEATH.

PROPANE GAS PIPING CHARTS

Sizing Between First and Second Stage Regulator

Maximum Propane Capacities listed are based on 2 PSIG Pressure Drop at 10 PSIG Setting. Capacities in 1000 BTU/HR

PIPE OR TUBING LENGTH, FEET	TUBING SIZE, O.D., TYPE L					NOMINAL PIPE SIZE, SCH 40	
	3/8"	1/2"	5/8"	3/4"	7/8"	1/2"	3/4"
10	730	1700	3200	5300	8300	3200	7500
20	500	1100	2200	3700	5800	2200	4200
30	400	920	2000	2900	4700	1800	4000
40	370	850	1700	2700	4100	1600	3700
50	330	770	1500	2400	3700	1500	3400
60	300	700	1300	2200	3300	1300	3100
80	260	610	1200	1900	2900	1200	2600
100	220	540	1000	1700	2600	1000	2300
125	200	490	900	1400	2300	900	2100
150	190	430	830	1300	2100	830	1900
175	170	400	780	1200	1900	770	1700
200	160	380	730	1100	1800	720	1500

To Convert to Capacities at 15 PSIG Settings -- Multiply by 1.130
To Convert to Capacities at 5 PSIG Settings -- Multiply by 0.879

Sizing Between Single or Second Stage Regulator and Appliance

Maximum Propane Capacities listed are based on 1/2" W.C. Pressure Drop at 11" W.C. Setting. Capacities in 1000 BTU/HR

PIPE OR TUBING LENGTH FEET	TUBING SIZE, O.D., TYPE L						NOMINAL PIPE SIZE, SCH 40				
	3/8"	1/2"	5/8"	3/4"	7/8"	1 7/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"
10	39	92	199	329	501	935	275	567	1071	2205	3307
20	26	62	131	216	346	630	189	393	732	1496	2299
30	21	50	107	181	277	500	152	315	590	1212	1858
40	19	41	90	145	233	427	129	267	504	1039	1559
50	18	37	79	131	198	376	114	237	448	913	1417
60	16	35	72	121	187	340	103	217	409	834	1275
80	13	29	62	104	155	289	89	185	346	724	1086
100	11	26	55	90	138	255	78	162	307	630	976
125	10	24	48	81	122	224	69	146	275	567	866
150	9	21	43	72	109	202	63	132	252	511	787
200	8	19	39	66	100	187	54	112	209	439	665
250	8	17	36	60	93	172	48	100	185	390	590

*DATA IN ACCORDANCE WITH NFPA PAMPHLET NO. 54

PROPANE TANK SIZING (MINIMUM)

MAXIMUM GAS NEEDED TO VAPORIZE*	TANK SIZE REQUIRED IF LOWEST OUTDOOR TEMPERATURE (AVG. FOR 24 HOURS) REACHES						
	32°F	20°F	10°F	0°F	-10°F	-20°F	-30°F
125K BTU/HR (50 CFH)	115 GAL	115 GAL	115 GAL	250 GAL	250 GAL	400 GAL	600 GAL
250K BTU/HR (100 CFH)	250 GAL	250 GAL	250 GAL	400 GAL	500 GAL	1000 GAL	1500 GAL
375K BTU/HR (150 CFH)	300 GAL	400 GAL	500 GAL	500 GAL	1000 GAL	1500 GAL	2500 GAL
500K BTU/HR (200 CFH)	400 GAL	500 GAL	750 GAL	1000 GAL	1500 GAL	2000 GAL	3500 GAL
750K BTU/HR (300 CFH)	750 GAL	1000 GAL	1500 GAL	2000 GAL	2500 GAL	4000 GAL	5000 GAL

* AVERAGE RATE/HOUR WITHDRAWL IN 8 HOUR PERIOD

SYSTEM OPERATION

COOLING

The refrigerant used in the system is R-22. It is clear, colorless, non-toxic, non-irritating, and non-explosive liquid. The chemical formula is $CHCLF_2$. The boiling point, at atmospheric pressure is -41.4°F.

A few of the important principles that make the refrigeration cycle possible are: heat always flows from a warmer to a cooler body, under lower pressure a refrigerant will absorb heat and vaporize at a low temperature, the vapors may be drawn off and condensed at a higher pressure and temperature to be used again.

The indoor evaporator coil functions to cool and dehumidify the air conditioned spaces through the evaporative process taking place within the coil tubes.

NOTE: The pressures and temperatures shown are for demonstration purposes only. Actual temperatures and pressures are to be obtained from the "Cooling Performance Chart."

High temperature, high pressure vapor leaves the compressor through the discharge line, through the reversing valve on heat pump models, and enters the condenser coil. Air drawn through the condenser coil by the condenser fan causes the refrigerant to condense into a liquid by removing heat from the refrigerant. As the refrigerant is cooled below its condensing temperature it becomes subcooled.

The subcooled high pressure liquid refrigerant now leaves the condenser coil via the liquid line until it reaches the indoor expansion device. (Heat pump models will also have an outdoor expansion valve/check valve assembly or a restrictor orifice installed in the liquid line).

As the refrigerant passes through the expansion device and into the evaporator coil a pressure drop is experienced causing the refrigerant to become a low pressure vapor. Low pressure saturated refrigerant enters the evaporator coil where heat is absorbed from the warm air drawn across the coil by the evaporator blower. As the refrigerant passes through the last tubes of the evaporator coil it becomes superheated, that is, it absorbs more heat than is necessary for the refrigerant to vaporize. Maintaining proper superheat assures that liquid refrigerant is not returning to the compressor which can lead to early compressor failure.

Low pressure superheated vapor leaves the evaporator coil and returns through the suction line to the compressor where the cycle begins again. On heat pump models the refrigerant must travel through the reversing valve and accumulator before returning to the compressor.

HEATING - Heat Pump Models

The heating portion of the refrigeration cycle is similar to the cooling cycle. The reversing valve reverses the flow of the refrigerant. The indoor coil now becomes the condenser coil and the outdoor coil becomes the evaporator coil. The reversing valve is energized in the cooling mode not in the heating mode as some previous models were.

The restrictor orifice or check valve at the indoor coil will open by the flow of refrigerant letting the now condensed liquid refrigerant bypass the indoor expansion device. The orifice or check valve at the outdoor coil will be forced closed by the refrigerant flow, thereby utilizing the outdoor expansion device.

COOLING CYCLE

All Models

When the contacts of the room thermostat close making terminals R to Y & to G, on the control board. Heat pumps thermostat make the R to O terminals also.

The control board recognizes this as a demand for cooling and energizes the compressor contactor, indoor blower motor. The blower delay is an integral part of the control board.

When the thermostat is satisfied, it opens its contacts, breaking the low voltage circuit, causing the compressor contactor to open and indoor fan to stop after a 30 second delay.

If the room thermostat fan selector switch should be set to the "on" position then the indoor blower would run continuous rather than cycling with the compressor.

HEATING CYCLE

Package Heat Pumps

When the thermostat calls for heat, making terminals R to Y, the low voltage circuit of the transformer is completed. The control board applies power to the contactor starting the compressor and outdoor fan motor. This also energizes the indoor blower relay (control board) through the room thermostat, starting the indoor blower motor.

When auxiliary electric heaters are used, a two stage heating single stage cooling thermostat would be installed.

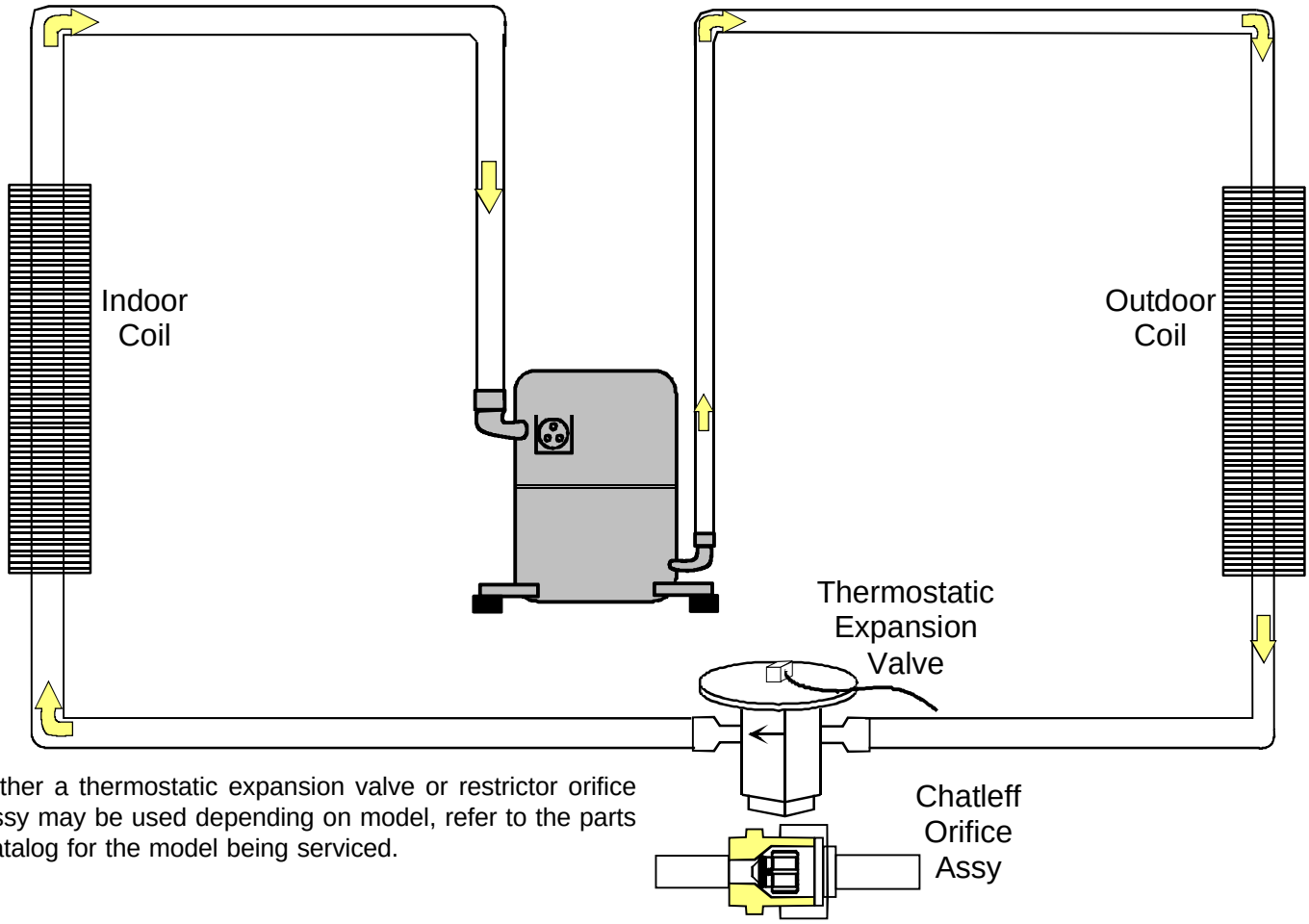
Should the second stage heating contacts in the room thermostat close, which would be wired to W at the unit control board, this would energize the coil of the electric heat relay(s). Contacts within the relay(s) will close, bringing on the resistance heaters.

If electric heaters should be used, they may be controlled by outdoor thermostats. (ATK01)

NOTE: Refer to the specifications section for the maximum heaters that may be installed for a specific unit.

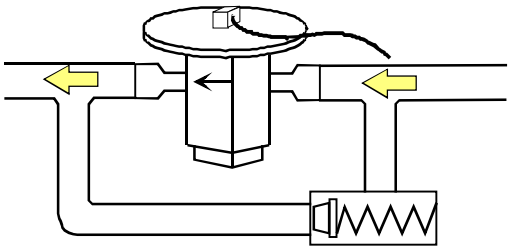
SYSTEM OPERATION

Typical Package Cooling or Package Gas

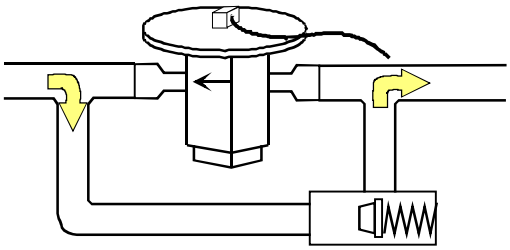


Either a thermostatic expansion valve or restrictor orifice assy may be used depending on model, refer to the parts catalog for the model being serviced.

Expansion Valve/Check Valve Assy in Cooling Operation

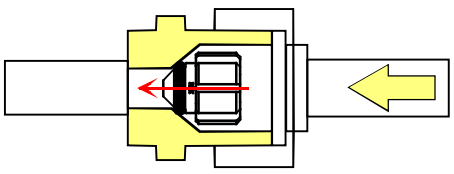


Expansion Valve/Check Valve Assy in Heating Operation



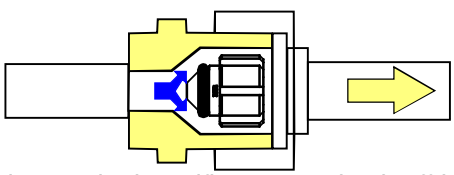
Most expansion valves used in current Amana Heat Pump products use an internally checked expansion valve. This type of expansion valve does not require an external check valve as shown above.

Restrictor Orifice Assy in Cooling Operation



In the cooling mode the orifice is pushed into its seat forcing refrigerant to flow through the metered hole in the center of the orifice.

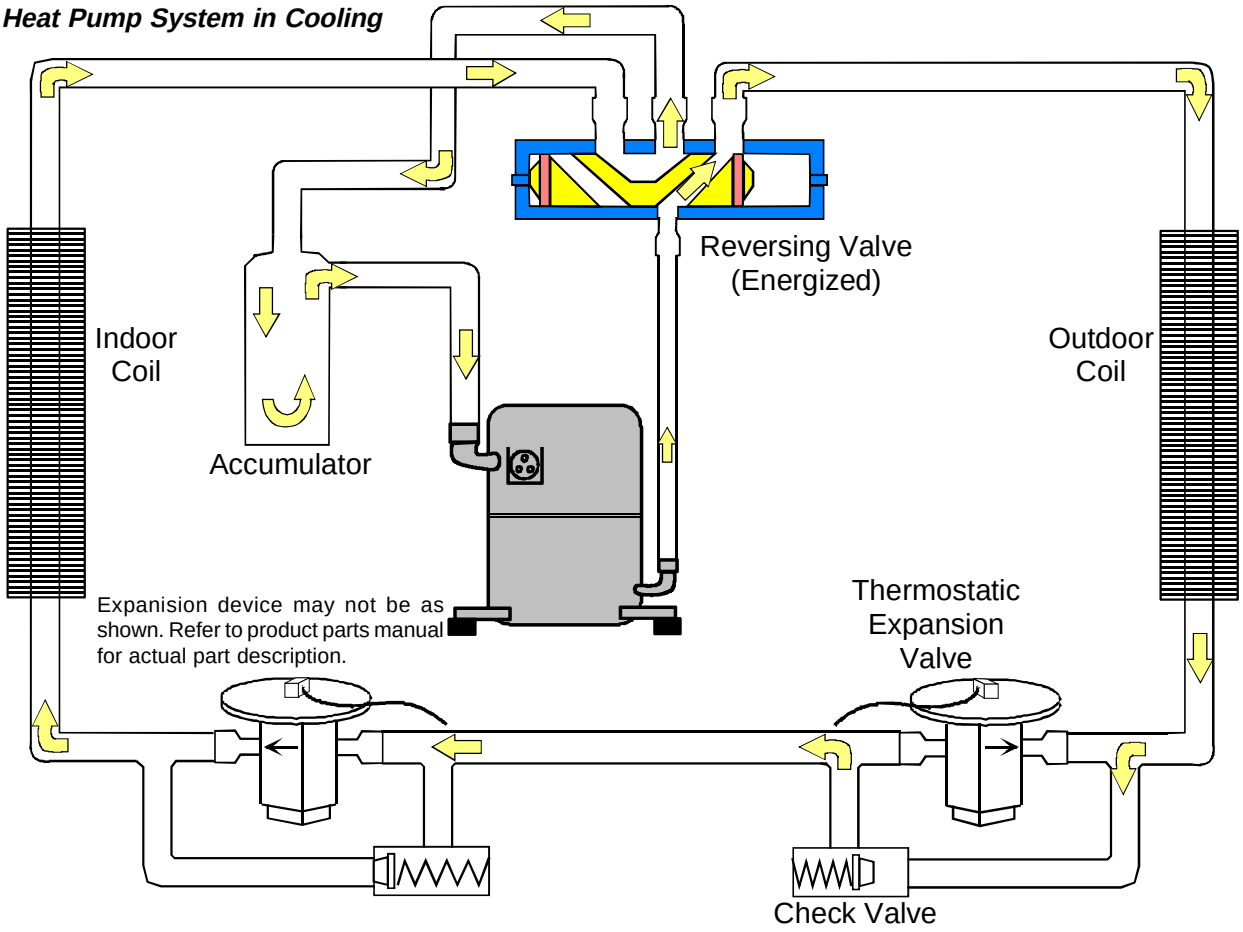
Restrictor Orifice Assy in Heating Operation



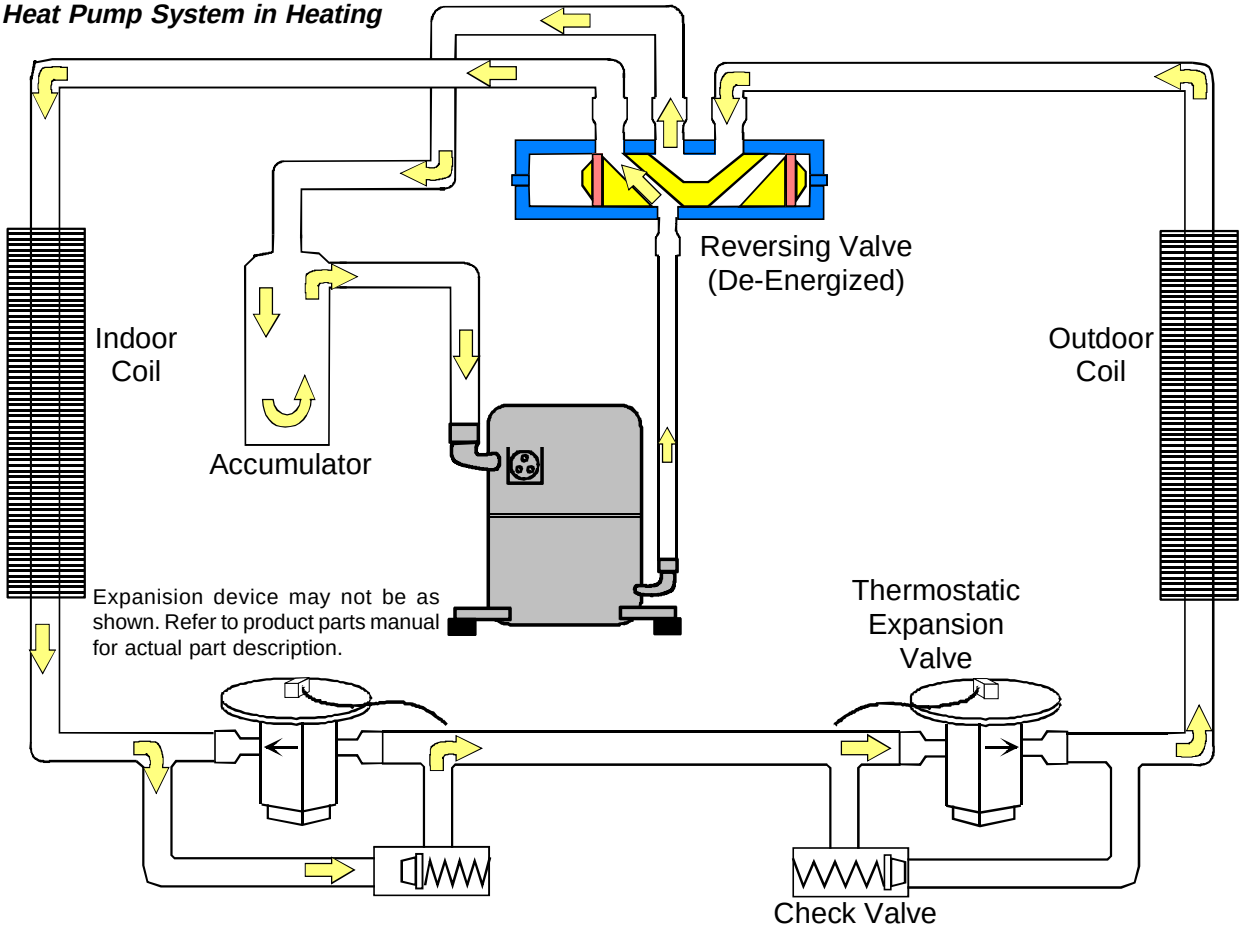
In the heating mode the orifice moves back off its seat allowing refrigerant to flow unmetered around the outside of the orifice.

SYSTEM OPERATION

Typical Heat Pump System in Cooling



Typical Heat Pump System in Heating



SYSTEM OPERATION

DEFROST CYCLE

Package Heat Pumps

The defrosting of the outdoor coil is jointly controlled by the defrost control board, defrost (30/60) control and compressor run time.

Solid State Timer

The defrost timer board can be connected for one of three (3) time intervals. 30 minutes, 60 minutes, and 90 minutes (Factory connected @ 60 min.). Package heat pumps manufactured after May 1999 (9905 Serial date code) will be factory set @ 30 min.

The timing interval can not begin until the outdoor coil temperature reaches approximately 30°F. (initiation temperature) at the defrost (30/60) control point of contact. As long as this point of contact does not reach 60°F. (termination temperature) the defrost timer board will count the number of minutes that the compressor runs.

At the end of this (one of three) time interval, the defrost board will call for defrost and enter the defrost mode. In this mode the control board will energize the reversing relay, de-energize the outdoor fan motor and energize the supplemental electric heat relay (if installed). When this occurs, the outdoor fan motor stops and the reversing valve changes to the cooling position sending hot refrigerant gas to the outdoor coil, which will melt any frost accumulation.

The defrost control board will stay in the defrost mode until the outdoor coil temperature reaches approximately 60°F. at the point of contact with the defrost (30/60) control or a maximum of 10 minutes compressor run time.

If the defrost cycle is terminated by temperature, then a new time interval count can not begin until the defrost (30/60) control again reaches approximately 30°F. at the point of contact. If the defrost cycle was terminated by time, then a new time interval could would begin immediately.

HEATING CYCLE

Package Gas Units

The heating cycle is accomplished by using a unique tubular design heat exchanger which provides efficient gas heating on either natural gas or propane gas fuels. The heat exchangers compact tubular construction provides excellent heat transfer for maximum operating efficiency.

Inshot type gas burners with integral cross lighters are used eliminating the need for adjustable air shutters. The same burner is designed for use on either natural or propane gas fuels.

The Induced Draft blower draws fuel and combustion air into the burners and heat exchanger for proper combustion. A pressure switch is used in conjunction with the I. D. blower to detect a blocked flue condition.

Blower operation is controlled by the ignition control module. The module provides for field adjustment of the blower delay at the end of the heating cycle. The range of adjustment is for 60, 90, 120, or 180 seconds. The factory delay setting is 30 seconds delay on 120 seconds delay off.

Honeywell Smart Valve Systems

Ignition is provided by an electronic ignition control and ceramic glow bar or direct spark ignitor which heats to approximately 2500°F. A flame sensor then monitors for the presence of flame and closes the gas valve if flame is lost.

The system may be controlled by most good heating and cooling thermostats with an adjustable heat anticipator. Some night setback thermostats that do not have a common terminal, use a power robbing circuit in the off cycle to maintain the batteries. This type of thermostat may interfere with the operation of the ignition control and should not be used.

Direct Spark Ignition (DSI) Systems

Amana PGA__C, PGB__C and PGD__C units built after July, 1999, are equipped with a direct spark ignition system. Ignition is provided by 20,000 volt electronic spark. A flame sensor then monitors for the presence of flame and closes the gas valve if flame is lost.

The system may be controlled by most good heating and cooling thermostats with an adjustable heat anticipator. Some night setback thermostats that do not have a common terminal, use a power robbing circuit in the off cycle to maintain the batteries. This type of thermostat may interfere with the operation of the ignition control module and should not be used.

HEATING SEQUENCE (Smart Valve and DSI Systems)

In order to illustrate the heating sequence, the following has been simplified to give a better understanding of the pressure switch operation.

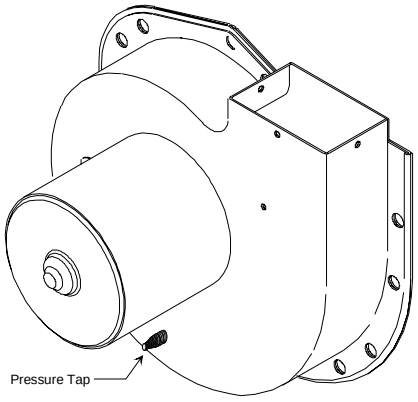


Figure 8

Figure 8 is a view of the induced draft blower showing the location of the pressure tap. The induced draft blower is mounted on the the collector box, the Heat Exchanger terminates into the collector box.

SYSTEM OPERATION

The pressure tap has a predetermined orifice size for reading static pressures. The induced draft blower motor assembly is mounted to the collector box. When the motor is in operation, a negative pressure will be created on the pressure tap, collector box and heat exchanger flue passages.

A pressure control using a single pole, single throw electrical switch is used as a safety device in case of a blocked flue.

The figure 9 illustrates the pressure control in an off position.

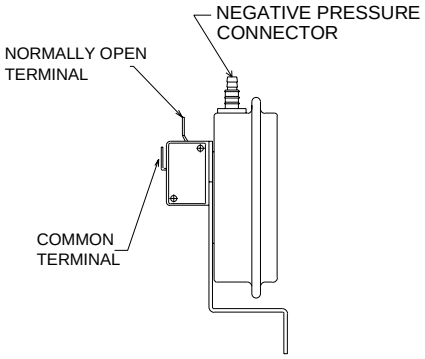


Figure 9

With the furnace in the off position the induced draft blower motor will not be running. Atmospheric pressure will therefore be on both sides of the diaphragm and the electrical switch will be open between (C) common and (NO) normally open terminals.

When the induced draft blower motor is in operation, the J-tube hose will create a negative pressure on one side of the diaphragm and atmospheric pressure will be on the other side causing the diaphragm to move toward the negative pressure.

This in turn will close the switch and make the (C) common to the (NO) normally open terminals.

In the event of partially restricted or blocked flue the induced draft blower will create less negative pressure and at approximately -0.32" $\pm$.06 W.C. negative pressure would open the contacts (C) to (NO).

OPERATING INSTRUCTIONS

1. Close the manual gas valve external to the unit.
2. Turn off the electrical power supply to the unit.
3. Set the room thermostat to its lowest possible setting.
4. Remove the heat exchanger door on the side of the unit by removing screws.
5. This unit is equipped with an ignition device which automatically lights the pilot. **DO NOT** try to light burner by any other method.
6. Turn the gas control valve knob to the OFF position. Do not force. Some Gas valves may have a different off/on style switch.

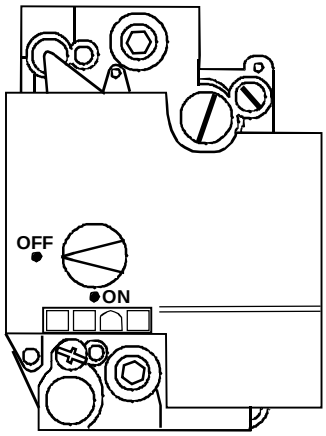


Figure 10

7. Wait five minutes to clear out any gas.
8. Smell for gas, including near the ground. This is important because some types of gas are heavier than air. If you have waited five minutes and you do smell gas, immediately follow the instructions on the Page 8 of this manual. If having waited for five minutes and no gas is smell is noted, turn the gas control valve knob to the ON position.
9. Replace the heat exchanger door on the side of the unit.
10. Open the manual gas valve external to the unit.
11. Turn on the electrical power supply to the unit.
12. Set the thermostat to desired setting.

NOTE: There is approximate 20 second delay between thermostat energizing and burner firing.

FAN OPERATION

Continuous Fan Mode

If the thermostat calls for continuous fan without a call for heat or cool, the indoor blower will be energized at the heat speed after a 7 second on delay. The fan remains energized as long as there is not a call for heat or cool. Once the call for continuous fan is de-energized, the indoor blower will go through a 30 second off delay.

If a call for cool occurs during continuous fan operation, the blower will switch to the cooling speed after the 7 second cool on delay.

If a call for heat occurs during continuous fan operation, the indoor blower will de-energize when the heat on blower delay begins. The heat cycle will control the indoor blower operation until the heat blower off delay is over. The continuous fan mode will function normally even while the control is in heat lockout.

SYSTEM OPERATION

ELECTRIC HEATERS

Optional electric heaters may be added, in the quantities shown in the specifications section to provide electric resistance heating. Under no condition shall more heaters than the quantity shown be installed.

The low voltage circuit in the blower section is factory wired and terminates at the location provided for the electric heater(s). A minimum of field wiring is required to complete the installation.

Other components such as a Heating/Cooling Thermostat, Outdoor Thermostat, and Compressor sound blankets are available to complete the installation.

The system CFM can be determined by measuring the static pressure external to the unit. The installation manual supplied with the unit shows the CFM for the static measured.

Alternately, the system CFM can be determined by operating the electric heaters and indoor blower WITHOUT having the compressor in operation. Measure the temperature rise as close to the blower inlet and outlet as possible.

If other than a 240V power supply is used, refer to the **BTUH CAPACITY CORRECTION FACTOR** chart below.

EXAMPLE: Five (5) heaters provide 24.0 KW at the rated 240V. Our actual measured voltage is 220V, and our measured temperature rise is 42°F. Find the actual CFM:

Answer: 24.0 KW, 42°F Rise, 240 V = 1800 CFM from the **TEMPERATURE RISE** chart below.

Heating output at 220 V = 24.0 x 3.413 x .84 - 68.8 MBh.

Actual CFM = 1800 x .84 = 1400 CFM.

NOTE: The temperature rise table is for sea level installations. The temperature rise at a particular KW and CFM will be greater at high altitudes, while the external static pressure at a particular CFM will be less.

FORMULAS:

Heating Output = KW x 3413 x Corr. Factor

Actual CFM = CFM (from table) x Corr. Factor

BTUH = KW x 3413

BTUH = CFM x 1.08 x Temperature Rise (ΔT)

$$CFM = \frac{KW \times 3413}{1.08 \times \Delta T}$$

$$\Delta T = \frac{BTUH}{CFM \times 1.08}$$

TEMPERATURE RISE (F) @ 240V							
CFM	4.8 K.W.	7.2 K.W.	9.6 K.W.	14.4 K.W.	19.2 K.W.	24.0 K.W.	28.8 K.W.
600	25	38	51	-	-	-	-
700	22	33	43	-	-	-	-
800	19	29	38	57	-	-	-
900	17	26	34	51	-	-	-
1000	15	23	30	46	-	-	-
1100	14	21	27	41	55	-	-
1200	13	19	25	38	50	-	-
1300	12	18	23	35	46	-	-
1400	11	16	22	32	43	54	65
1500	10	15	20	30	40	50	60
1600	9	14	19	28	38	47	57
1700	9	14	18	27	36	44	53
1800	8	13	17	25	34	42	50
1900	8	12	16	24	32	40	48
2000	8	12	15	23	30	38	45
2100	7	11	14	22	29	36	43
2200	7	11	14	21	27	34	41
2300	7	10	13	20	26	33	39

BTUH CAPACITY CORRECTION FACTOR							
SUPPLY VOLTAGE	480	460	440	250	230	220	208
MULTIPLICATION FACTOR	1.09	1.00	.91	1.08	.92	.84	.75

Heater Capacity @ 240 VAC						
Heater Kit	**kW**	**BTUH**	**Minimum Circuit Ampacity**		**Maximum Overcurrent Protection**	
			L1 - L2	**L3 - L4**	**L1 - L2**	**L3 - L4**
PHCB05C1	4.8	16,400	25	--	30	--
PHCB10C1	9.6	32,800	50	--	60	--
PHCB15C1	14.4	49,100	50	25	60	30
PHCB20C1	19.2	65,500	50	50	60	60

SCHEDULED MAINTENANCE

The owner should be made aware of the fact, that, as with any mechanical equipment the remote air conditioner requires regularly scheduled maintenance to preserve high performance standards, prolong the service life of the equipment, and lessen the chances of costly failure.

In many instances the owner may be able to perform some of the maintenance; however, the advantage of a service contract, which places all maintenance in the hands of a trained serviceman, should be pointed out to the owner.

⚠ WARNING

DISCONNECT POWER SUPPLY BEFORE SERVICING

ONCE A MONTH

1. Inspect the return filters of the evaporator unit and clean or change if necessary. **NOTE:** Depending on operation conditions, it may be necessary to clean the filters more often. If permanent type filters are used, they should be washed with warm water, dried and sprayed with an adhesive according to manufacturers recommendations.
2. When operating on the cooling cycle, inspect the condensate line piping from the evaporator coil. Make sure the piping is clear for proper condensate flow.

ONCE A YEAR

Qualified Service Personnel Only

1. Clean the indoor and outdoor coils.
2. Clean the casing of the outdoor unit inside and out .
3. Motors are permanently lubricated and do not require oiling. TO AVOID PREMATURE MOTOR FAILURE, DO NOT OIL.
4. Manually rotate the outdoor fan and indoor blower to be sure they run freely.
5. Inspect the control panel wiring, compressor connections, and all other component wiring to be sure all connections are tight. Inspect wire insulation to be certain that it is good.
6. Check the contacts of the compressor contactor. If they are burned or pitted, replace the contactor.
7. Using a halide or electronic leak detector, check all piping and etc. for refrigerant leaks.
8. Check the combustion chamber (Heat Exchanger) for soot, scale, etc. Inspect all burners for lint and proper positioning.
9. Start the system, using the proper instrumentation check gas inlet and manifold pressures, burner flame and microamp signal. Adjust if necessary.
10. Start the system and run both a Cooling & Heating Performance Test. If the results of the test are not satisfactory, see the "Service Problem Analysis" Chart of the possible cause.

TEST EQUIPMENT

Proper test equipment for accurate diagnosis is as essential as regular hand tools.

The following is a must for every service technician and service shop:

1. Thermocouple type temperature meter - measure dry bulb temperature.
2. Sling psychrometer- measure relative humidity and wet bulb temperature.
3. Amprobe - measure amperage and voltage.
4. Refrigeration Test Cord - check compressors, motors, and continuity testing.
5 Volt-Ohm Meter - testing continuity, capacitors, and motor windings.
6. Accurate Leak Detector - testing for refrigerant leaks.
7. High Vacuum Pump - evacuation.
8. Electric Vacuum Gauge, Manifold Gauges and high vacuum hoses - to measure and obtain proper vacuum.
9. Accurate Charging Cylinder or Electronic Scale - measure proper refrigerant charge.
10. Inclined Manometer - measure static pressure and pressure drop across coils.

Other recording type instruments can be essential in solving abnormal problems, however, in many instances they may be rented from local sources.

Proper equipment promotes faster, more efficient service, and accurate repairs with less call backs.

COOLING & HEATING PERFORMANCE TEST

Package Cooling and Package Heat Pumps

Before attempting to diagnose an operating fault, run a Cooling and/or Heating Performance Test and apply the results to the Service Problem Analysis Guide.

Package Gas Units

Before attempting to diagnose an operating fault, run a heating performance test and apply the results to the Service Problem Analysis Guide.

To conduct a heating performance test, the BTU input to the furnace must be calculated.

After the heating cycle has been in operation for at least fifteen minutes and with all other gas appliances turned off, the gas meter should be clocked.

To find the BTU input, multiply the number of cubic feet of gas consumed per hour by the heating value of the gas being used. (The calorific value of the gas being used is found by contacting your local utility.)

Example:

It is found by the gas meter, that it takes forty (40) seconds for the hand on the cubic foot dial to make one complete revolution, with all appliances off, except the furnace. Take this information and locate it on the gas rate chart. Observe the forty (40) seconds, locate and read across to the one (1) cubic foot dial column. There we find the number 90, which shows that ninety (90) cubic feet of gas will be consumed in one (1) hour.

Let's assume the local gas utility has stated that the calorific value of the gas is 1025 BTU.

Multiplying the ninety (90) cubic feet by 1025 BTU gives us an input of 92,250 BTUH.

Checking the BTU input on the rating plate of the furnace being tested.

EXAMPLE: PGB30C0902D

INPUT: 90,000 BTU/HR

OUTPUT CAP: 72,000

Should the figure you calculated not fall within five (5) percent of the nameplate rating of the unit, adjust the gas valve pressure regulator or resize orifices. **In no case should the input exceed that shown on the rating plate.**

⚠ CAUTION

ALWAYS CONNECT A MANOMETER TO THE 1/8" PIPE TAP AT THE GAS VALVE BEFORE ADJUSTING THE PRESSURE REGULATOR. IN NO CASE SHOULD THE FINAL MANIFOLD PRESSURE VARY MORE THAN PLUS OR MINUS .3 INCHES WATER COLUMN FROM 3.5 INCHES WATER COLUMN FOR NATURAL GAS OR 10 INCHES WATER COLUMN FOR PROPANE GAS.

To adjust the pressure regulator on the gas valve, turn down (clockwise) to increase pressure and input, and out (counterclockwise) to decrease pressure and input.

Since normally propane gas is not installed with a gas meter, clocking will be virtually impossible. The gas orifices used with propane are calculated for 2500 BTU gas and with proper inlet pressures and correct piping size, full capacity will be obtained.

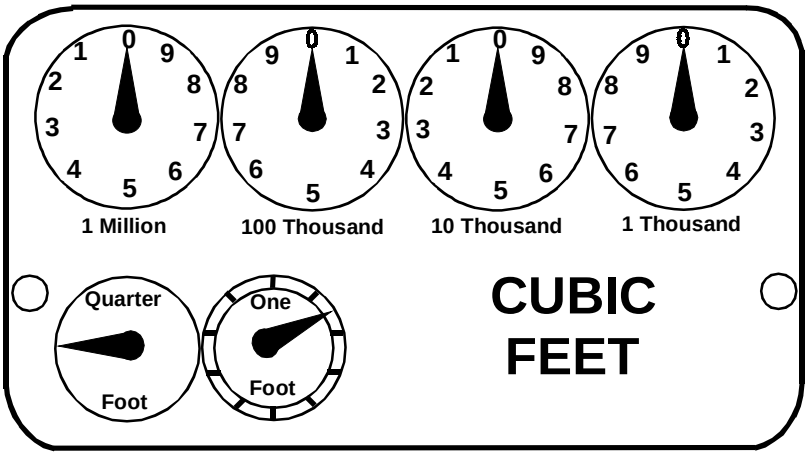
With propane gas, no unit gas valve regulator is used; however, the second stage supply line pressure regulator should be adjusted to give 11" water column with all other gas consuming appliances running.

The dissipation of the heat transferred to the heat exchanger is now controlled by the amount of air circulated over its surface.

The amount (CFM) of air circulated is governed by the external static pressure in inches of water column of duct work, cooling coil, registers and etc., applied externally to the unit versus the motor speed tap.

A properly operating unit must have the BTU input and CFM of air, within the limits shown to prevent short cycling of the equipment. As the external static pressure goes up, the temperature rise will also increase. Consult the proper tables for temperature rise limitation.

SERVICING



GAS RATE -- CUBIC FEET PER HOUR

Seconds for One Revolution	Size of Test Dial 1/4 cu/ft	1/2 cu/ft	1 cu/ft	2 cu/ft	5 cu/ft	Seconds for One Revolution	Size of Test Dial 1/4 cu/ft	1/2 cu/ft	1 cu/ft	2 cu/ft	5 cu/ft
10	90	180	360	720	1800	36	25	50	100	200	500
11	82	164	327	655	1636	37	--	--	97	195	486
12	75	150	300	600	1500	38	23	47	95	189	474
13	69	138	277	555	1385	39	--	--	92	185	462
14	64	129	257	514	1286	40	22	45	90	180	450
15	60	120	240	480	1200	41	--	--	--	176	439
16	56	113	225	450	1125	42	21	43	86	172	429
17	53	106	212	424	1059	43	--	--	--	167	419
18	50	100	200	400	1000	44	--	41	82	164	409
19	47	95	189	379	947	45	20	40	80	160	400
20	45	90	180	360	900	46	--	--	78	157	391
21	43	86	171	343	857	47	19	38	76	153	383
22	41	82	164	327	818	48	--	--	75	150	375
23	39	78	157	313	783	49	--	--	--	147	367
24	37	75	150	300	750	50	18	36	72	144	360
25	36	72	144	288	720	51	--	--	--	141	355
26	34	69	138	277	692	52	--	--	69	138	346
27	33	67	133	265	667	53	17	34	--	136	340
28	32	64	129	257	643	54	--	--	67	133	333
29	31	62	124	248	621	55	--	--	--	131	327
30	30	60	120	240	600	56	16	32	64	129	321
31	--	--	116	232	581	57	--	--	--	126	316
32	28	56	113	225	563	58	--	31	62	124	310
33	--	--	109	218	545	59	--	--	--	122	305
34	26	53	106	212	529	60	15	30	60	120	300
35	--	--	103	206	514						

SERVICING

COOLING OR HEAT PUMP - SERVICE ANALYSIS GUIDE

Complaint	No Cooling / Heating							Unsatisfactory Clg / Htg								System Operating Pressures				Test Method Remedy	See Service Procedure Ref.
POSSIBLE CAUSE **DOTS IN ANALYSIS GUIDE INDICATE "POSSIBLE CAUSE"** **SYMPTOM**	System will not start	Compressor will not start - fan runs	Comp. and Cond. Fan will not start	Evaporator fan will not start	Condenser fan will not start	Compressor runs - goes off on overload	Compressor cycles on overload	System runs continuously - little clg / htg	Too cool and then too warm	Not cool enough on warm days	Certain areas to cool others to warm	Compressor is noisy	System run blows cold air (Heating)	Unit will not terminate defrost	Unit will not defrost	Low suction pressure	Low head pressure	High suction pressure	High head pressure		
Power Failure	●																			Test Voltage	S-1
Blown Fuse	●		●	●																Imspect Fuse Size & Type	S-4
Loose Connection	●			●		●														Inspect Connection - Tighten	S-2
Shorted or Broken Wires	●	●	●	●	●	●														Test Circuits With Ohmmeter	S-3
Open Overload		●		●	●								♦							Test Continuity of Overload	S-17A
Faulty Thermostat	●			●					●											Test continuity of Thermostat & Wiring	S-3
Faulty Transformer	●		●																	Check control circuit with voltmeter	S-4
Shorted or Open Capacitor		●			●	●														Test Capacitor	S-15
Shorted or Grounded Compressor		●				●														Test Motor Windings	S-17B
Compressor Stuck	●					●														Use Test Cord	S-17C
Faulty Compressor Contactor	●	●			●	●														Test continuity of Coil & Contacts	S-7, S-8
Faulty Fan Relay				●																Test continuity of Coil And Contacts	S-7
Open Control Circuit				●																Test Control Circuit with Voltmeter	S-4
Low Voltage		●				●	●													Test Voltage	S-1
Faulty Evap. Fan Motor				●												●				Repair or Replace	S-16
Shorted or Grounded Fan Motor					●														●	Test Motor Windings	S-16
Improper Cooling Anticipator							●		●											Check resistance of Anticipator	S-3
Shortage or Refrigerant							●	●								●	●			Test For Leaks, Add Refrigerant	S-103
Restricted Liquid Line							●	●								●	●			Replace Restricted Part	S-112
Dirty Air Filter								●		●	●					●			♦	Inspect Filter-Clean or Replace	
Dirty Indoor Coil								●		●	●					●			♦	Inspect Coil - Clean	
Not enough air across Indoor Coil								●		●	●					●			♦	Speed Blower, Check Duct Static Press	S-200
Too much air across Indoor Coil																		●		Reduce Blower Speed	S-200
Overcharge of Refrigerant						●	●					●						●	●	Release Part of Charge	S-113
Dirty Outdoor Coil						●	●			●						♦			●	Inspect Coil - Clean	
Noncondensibles							●			●									●	Remove Charge, Evacuate, Recharge	S-114
Recirculation of Condensing Air							●			●									●	Remove Obstruction to Air Flow	
Infiltration of Outdoor Air								●		●	●									Check Windows, Doors, Vent Fans, Etc.	
Improperly Located Thermostat						●			●											Relocate Thermostat	
Air Flow Unbalanced									●		●									Readjust Air Volume Dampers	
System Undersized								●		●										Refigure Cooling Load	
Broken Internal Parts												●								Replace Compressor	
Inefficient Compressor								●					♦				●	●		Test Compressor Efficiency	S-104
High Pressure Control Open			●																	Reset And Test Control	S-12
Unbalanced Power, 3PH		●				●	●													Test Voltage	
Wrong Type Expansion Valve						●	●			●										Replace Valve	
Expansion Device Restricted						●	●	●		●						●	●			Replace Valve	
Expansion Valve Bulb Loose												●						●		Tighten Bulb Bracket	
Inoperative Expansion Valve						●		●								●				Check Valve Operation	S-110
Loose Hold-down Bolts												●								Tighten Bolts	
Faulty Reversing Relay			♦										♦							Test continuity of Coil And Contacts	S-7
Faulty Defrost Relay														♦	♦					Test continuity of Coil And Contacts	S-7
Faulty Reversing Valve						●							♦	♦	♦		●	●		Test Valve Operation	S-21
Leaking Check Valve/Orifice								●									●	●		Replace Check Valve	
Faulty Defrost Timer														♦	♦					Test Timer Operation	S-23/24
Faulty 30/60 Control															♦					Test Control	S-25
Additional Opt Elect. Heat Req.								♦												Run Load Calculation, Add Heaters	
Open fuse or limit in Elect. Htr								♦												Inspect Fuses and Limits	S-50
O.D. Thermostat setting to Low								♦												Raise Setting	

● Clg or Htg Cycle ♦ Heat Pump Cycle only

SERVICING

GAS HEATING - SERVICE ANALYSIS GUIDE

Complaint	No Heat			Unsatisfactory Heat						Test Method Remedy	See Service Procedure Reference
POSSIBLE CAUSE DOTS IN ANALYSIS GUIDE INDICATE "POSSIBLE CAUSE" SYMPTOM	System Will Not Start	Burner Won't Ignite	Burner Ignites-Locks Out	Burner Shuts Off prior to T'Stat being Satasfied	Short Cycles	Long Cycles	Soot and /or Fumes	To Much Heat	Not Enough Heat		
Power Failure	●									Test Voltage	S-1
Blown Fuse	●									Test Voltage	S-4
Loose Connection	●									Check Wiring	S-2
Shorted or Broken Wires	●									Check Wiring	S-3
No Low Voltage	●									Check Transformer	S-4
Faulty Thermostat	●				●	●		●		Check Thermostat	S-3
Faulty Transformer	●									Check Transformer	S-4
Poor or High Resistance Ground			●							Measure Ground Resistance	S-313
Improper Heat Anticipator Setting					●	●		●	●	Adjust Heat Anticipator Setting	S-3
Improper Thermostat Location					●	●		●	●	Relocate Thermostat	
Faulty Limit or Roll Out Switch		●		●						Test Control	S-300-302
Faulty Flame Sensor			●							Test Flame Sensor	S-314
Faulty Ignition Control		●	●							Test Control	S-313
Gas Valve or Gas Supply Shut Off		●								Turn Valves to On Position	S-304
Faulty Induced Draft Blower		●					●			Test Blower	S-309
Broken or Shorted Ignitor		●								Test Ignitor	S-312
Faulty Combustion Relay		●		●						Test Relay	S-20
Dirty Flame Sensor, Low uA			●							Clean Flame Sensor	S-314
Flame Sensor not in Flame, Low uA			●							Test/Adjust Position of Flame Sensor	S-314
Faulty Gas Valve		●					●		●	Replace Gas Valve	S-304
Open Auxillary Limit		●		●						Reset Control	S-301
Improper Air Flow or Distribution				●					●	Check Duct Static	
Cycling on Limit				●	●				●	Check Controls & Temperature Rise	S-300
Delayed Ignition							●			Test for Delayed Ignition	S-308
Flashback							●			Test for Flashback	S-309
Orifice Size							●	●	●	Check Orifices	S-306
Gas Pressure		●					●	●	●	Check Gas Pressure	S-307
Cracked Heat Exchanger							●			Check Burner Flames	S-302
Stuck Gas Valve		●					●	●		Replace Gas Valve	S-304
Furnace Undersized									●	Replace with Proper Size Furnce	
Faulty Pressure Switch		●	●	●						Test Pressure Switch	S-310
Blocked or Restricted Flue							●			Check Flue/Drawdown Pressure	S-310
Open Roll Out Switch		●	●							Test Control	S-302
Collector Box "J" Tube Position		●	●							Test Negative Pressure	S-310
Bouncing On Pressure Switch			●							Test Negative Pressure	S-310

SERVICING

S-1 CHECKING VOLTAGE

WARNING

Disconnect Electrical Power Supply:

1. Remove doors, control panel cover, etc. from unit being tested.

With power ON:

WARNING

LINE VOLTAGE NOW PRESENT

2. Using a voltmeter, measure the voltage across terminals L1 and L2 of the contactor for single phase units, and L3, for 3 phase units.
3. No reading - indicates open wiring, open fuse(s) no power or etc. from unit to fused disconnect service. Repair as needed.
4. With ample voltage at line voltage connectors, energize the unit.
5. Measure the voltage with the unit starting and operating, and determine the unit Locked Rotor Voltage. NOTE: If checking heaters, be sure all heating elements are energized.

   Locked Rotor Voltage is the actual voltage available at the compressor during starting, locked rotor, or a stalled condition. Measured voltage should be above minimum listed in chart below.

   To measure Locked Rotor Voltage attach a voltmeter to the run "R" and common "C" terminals of the compressor, or to the T_1 and T_2 terminals of the contactor. Start the unit and allow the compressor to run for several seconds, then shut down the unit. Immediately attempt to restart the unit while measuring the Locked Rotor Voltage.
6. Should read within the voltage tabulation as shown. If the voltage falls below the minimum voltage, check the line wire size. Long runs of undersized wire can cause low voltage. If wire size is adequate, notify the local power company in regards to either low or high voltage.

UNIT SUPPLY VOLTAGE		
VOLTAGE	MIN.	MAX.
460	437	506
208/230	198	253

NOTE: When operating electric heaters on voltages other than 240 volts refer to the System Operation section on electric heaters to calculate temperature rise and air flow. Low voltage may cause insufficient heating.

Three phase units require a balanced 3 phase power supply to operate. If the percentage of voltage imbalance exceeds 3% the unit must not be operated until the voltage condition is corrected.

$$\text{\% Voltage Imbalance} = \frac{\text{Max. Voltage Deviation From Average Voltage}}{\text{Average Voltage}} \times 100$$

To find the percentage of imbalance, measure the incoming power supply.

L1 - L2 = 240V
L1 - L3 = 232V
L2 - L3 = 238V
Total 710V

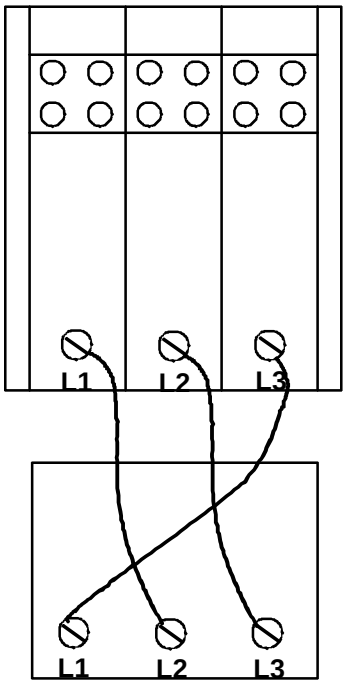
Avg. V = 710 / 3 = **236.7**

To find Max. deviation:
240 - 236.7 = +3.3
232 - 236.7 = **-4.7**
238 - 236.7 = +1.3

Max deviation was 4.7V

% Voltage Imbalance = 4.7 / 236.7 = **1.99%**

If the percentage of imbalance had exceeded 3%, it must be determined if the imbalance is in the incoming power supply or the equipment. To do this rotate the legs of the incoming power and retest voltage as shown below.



L1 - L2 = 240V
L1 - L3 = 227V
L2 - L3 = 238V

Rotate all 3 incoming legs as shown.

L1 - L2 = 227V
L1 - L3 = 238V
L2 - L3 = 240V

By the voltage readings we see that the imbalance rotated or traveled with the switching of the incoming legs. Therefore the power lies within the incoming power supply.

If the imbalance had not changed then the problem would lie within the equipment. Check for current leakage, shorted motors, etc.

SERVICING

S-2 CHECKING WIRING

WARNING

Disconnect Electrical Power Supply:

1. Check wiring visually for signs of overheating, damaged insulation and loose connections.
2. Use an ohmmeter to check continuity of any suspected open wires.
3. If any wires must be replaced, replace with comparable gauge and insulation thickness.

S-3 CHECKING THERMOSTAT, WIRING, AND ANTICIPATOR

S-3A Thermostat and Wiring

WARNING

LINE VOLTAGE NOW PRESENT

With power ON and thermostat calling for cooling.

1. Use a voltmeter to check for 24 volts at thermostat wires C and Y in the condensing unit control panel.
2. No voltage indicates trouble in the thermostat, wiring or external transformer source.
3. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

Indoor Blower Motor

With power ON:

WARNING

LINE VOLTAGE NOW PRESENT

1. Set fan selector switch at thermostat to "ON" position.
2. With voltmeter, check for 24 volts at wires C and G.
3. No voltage, indicates the trouble is in the thermostat or wiring.
4. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

Resistance Heaters

1. Set room thermostat to a higher setting than room temp so both stages call for heat.
2. With voltmeter, check for 24 volts at each heater relay.
3. No voltage, indicates the trouble is in the thermostat or wiring.
4. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

NOTE: Consideration must be given as to how the heaters are wired (O.D.T. and etc.). Also safety devices must be checked for continuity.

S-3B Cooling Anticipator

The cooling anticipator is a small heater (resistor) in the thermostat. During the "off" cycle it heats the bimetal element helping the thermostat call for the next cooling cycle. This prevents the room temperature from rising too high before the system is restarted. A properly sized anticipator should maintain room temperature within 1 1/2 to 2 degree range.

The anticipator is supplied in the thermostat and is not to be replaced. If the anticipator should fail for any reason, the thermostat must be changed.

S-3C Heating Anticipator

The heating anticipator is a wire-wound adjustable heater, which is energized during the "ON" cycle to help prevent overheating of the conditioned space.

The anticipator is a part of the thermostat and if it should fail for any reason, the thermostat must be replaced. See the following for recommended heater anticipator setting.

The first stage heat anticipator setting for heat pump models is .40. The heat anticipator setting for the package gas models is .80.

S-4 CHECKING TRANSFORMER AND CONTROL CIRCUIT

A step-down transformer (208/240 volt primary to 24 volt secondary) is provided with each package unit. This allows ample capacity for use with resistance heaters.

WARNING

Disconnect Electrical Power Supply:

1. Remove control panel cover or etc. to gain access to transformer.

With power ON:

WARNING

LINE VOLTAGE NOW PRESENT

2. Using a voltmeter, check voltage across secondary voltage side of transformer (R to C).
3. No voltage indicates faulty transformer, bad wiring, or bad splices.
4. Check transformer primary voltage at incoming line voltage connections and/or splices.

5 If line voltage available at primary voltage side of transformer and wiring and splices good, transformer is inoperative. Replace.

S-6 CHECKING TIME DELAY RELAY

Time delay relays are used in Amana Package Units to improve efficiency by delaying the blower off time. This feature is incorporated into the electronic controls. See S-23 to check control board.

SERVICING

S-7 CHECKING CONTACTOR AND/OR RELAYS

The compressor contactor and other relay holding coils are wired into the low or line voltage circuits. When the control circuit is energized the coil pulls in the normally open contacts or opens the normally closed contacts. When the coil is de-energized, springs return the contacts to their normal position.

⚠ WARNING

Disconnect Electrical Power Supply:

1. Remove the leads from the holding coil.
2. Using an ohmmeter, test across the coil terminals.

If the coil does not test continuous, replace the relay or contactor.

S-8 CHECKING CONTACTOR CONTACTS

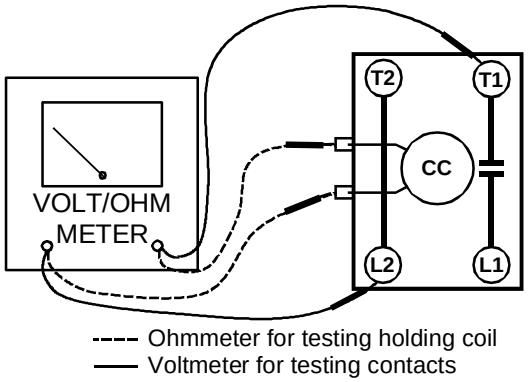
⚠ WARNING

Disconnect Electrical Power Supply:

1. Disconnect the wire leads from the terminal (T) side of the contactor.
2. With power ON, energize the contactor.

⚠ WARNING

LINE VOLTAGE NOW PRESENT



TESTING COMPRESSOR CONTACTOR

3. Using a voltmeter, test across terminals.
   A. L2 - T1 - No voltage indicates CC1 contacts open.

If a no voltage reading is obtained - replace the contactor.

S-9 CHECKING FAN RELAY CONTACTS

The fan relays are incorporated into the control board. See sections S-23 for checking control board.

NOTE: Some variation over time has occurred in the fan relays used. Refer to the unit wiring diagram for terminal identification.

S-15 CHECKING CAPACITOR

CAPACITOR, RUN

A run capacitor is wired across the auxiliary and main windings of a single phase permanent split capacitor motor. The capacitors primary function is to reduce the line current while greatly improving the torque characteristics of a motor. This is accomplished by using the 90° phase relationship between the capacitor current and voltage in conjunction with the motor windings so that the motor will give two phase operation when connected to a single phase circuit. The capacitor also reduces the line current to the motor by improving the power factor.

CAPACITOR, START

SCROLL COMPRESSOR MODELS

Hard start components are not required on Scroll compressor equipped units due to a non-replaceable check valve located in the discharge line of the compressor. However hard start kits are available and may improve low voltage starting characteristics.

This check valve closes off high side pressure to the compressor after shut down allowing equalization through the scroll flanks. Equalization requires only about one or two seconds during which time the compressor may turn backwards.

To prevent the compressor from starting and running backwards a Time Delay Relay (Cycle Protector) has been added to the low voltage circuit.

NOTE: K3 series scroll compressors have an anti-rotation device and equalizing mechanism incorporated into the compressor and will equalize in 0.2 to 0.3 seconds. These compressors will operate correctly without a Time Delay Relay.

MODELS EQUIPPED WITH A HARD START DEVICE

A start capacitor is wired in parallel with the run capacitor to increase the starting torque. The start capacitor is of the electrolytic type, rather than metallized polypropylene as used in the run capacitor.

A switching device must be wired in series with the capacitor to remove it from the electrical circuit after the compressor starts to run. Not removing the start capacitor will overheat the capacitor and burn out the compressor windings.

These capacitors have a 15,000 ohm, 2 watt resistor wired across its terminals. The object of the resistor is to discharge the capacitor under certain operating conditions, rather than having it discharge across the closing of the contacts within the switching device such as the Start Relay, and to reduce the chance of shock to the servicer. See the Servicing Section for specific information concerning capacitors.

SERVICING

RELAY, START

A potential or voltage type relay is used to take the start capacitor out of the circuit once the motor comes up to speed. This type of relay is position sensitive. The normally closed contacts are wired in series with the start capacitor and the relay holding coil is wired parallel with the start winding. As the motor starts and comes up to speed, the increase in voltage across the start winding will energize the start relay holding coil and open the contacts to the start capacitor.

Two quick ways to test a capacitor are a resistance and a capacitance check.

S-15A Resistance Check

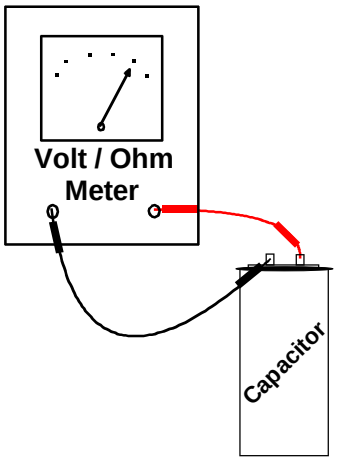
WARNING

Disconnect Electrical Power Supply:

1. Discharge capacitor and remove wire leads.

WARNING

DISCHARGE CAPACITOR THROUGH A 20 TO 30 OHM RESISTER BEFORE HANDLING.



TESTING CAPACITOR RESISTANCE

2. Set an ohmmeter on its highest ohm scale and connect the leads to the capacitor -

   A. Good Condition - indicator swings to zero and slowly returns to infinity. (Start capacitor will bleed resistor will not return to infinity. It will still read the resistance of the resistor).

   B. Shorted - indicator swings to zero and stops there - replace.

   C. Open - no reading - replace. (Start capacitor would read resistor resistance).

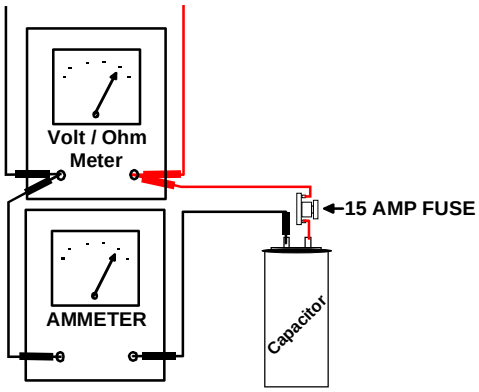
S-15B Capacitance Check

Using a hookup as shown below, take the amperage and voltage readings and use them in the formula:

WARNING

DISCHARGE CAPACITOR THROUGH A 20 TO 30 OHM RESISTOR BEFORE HANDLING.

Capacitance (MFD) = $\frac{2650 \times \text{Amperage}}{\text{Voltage}}$



TESTING CAPACITANCE

S-16 CHECKING FAN AND BLOWER MOTOR

An auto reset fan motor overload is designed to protect the motor against high temperature and high amperage conditions similar to the compressor internal overload. It also breaks the common circuit within the motor shell; however, heat generated within the motor is faster to dissipate than the compressor, allow at least 45 minutes for the overload to reset, then retest.

WARNING

Disconnect Electrical Power Supply:

1. Remove the motor leads from its respective connection points and capacitor (if applicable).
2. Check the continuity between each of the motor leads.
3. Touch one probe of the ohmmeter to the motor frame (ground) and the other probe in turn to each lead.

If the windings do not test continuous or a reading is obtained from lead to ground, replace the motor.

S-17 CHECKING COMPRESSOR WINDINGS

WARNING

HERMETIC COMPRESSOR ELECTRICAL TERMINAL VENTING CAN BE DANGEROUS. WHEN INSULATING MATERIAL WHICH SUPPORTS A HERMETIC COMPRESSOR ELECTRICAL TERMINAL SUDDENLY DISINTEGRATES DUE TO PHYSICAL ABUSE OR AS A RESULT OF AN ELECTRICAL SHORT BETWEEN THE TERMINAL AND THE COMPRESSOR HOUSING, THE TERMINAL MAY BE EXPELLED, VENTING THE VAPOROUS AND LIQUID CONTENTS OF THE COMPRESSOR HOUSING AND SYSTEM.

SERVICING

If the compressor terminal PROTECTIVE COVER and gasket (if required) is not properly in place and secured, there is a remote possibility if a terminal vents, that the vaporous and liquid discharge can be ignited, spouting flames several feet, causing potentially severe or fatal injury to anyone in its path.

This discharge can be ignited external to the compressor if the terminal cover is not properly in place and if the discharge impinges on a sufficient heat source.

Ignition of the discharge can also occur at the venting terminal or inside the compressor, if there is sufficient contaminant air present in the system and an electrical arc occurs as the terminal vents.

Ignition cannot occur at the venting terminal without the presence of contaminant air, and cannot occur externally from the venting terminal without the presence of an external ignition source.

Therefore, proper evacuation of a hermetic system is essential at the time of manufacture and during servicing.

To reduce the possibility of external ignition, all open flame, electrical power, and other heat sources should be extinguished or turned off prior to servicing a system.

If the following test indicates shorted, grounded or open windings, see procedures S-19 for the next steps to be taken.

S-17A Resistance Test

Each compressor is equipped with an internal overload.

The line break internal overload senses both motor amperage and winding temperature. High motor temperature or amperage heats the disc causing it to open, breaking the common circuit within the compressor on single phase units. The three phase internal overload will open all three legs.

Heat generated within the compressor shell, usually due to recycling of the motor, high amperage or insufficient gas to cool the motor, is slow to dissipate, allow at least three to four hours for it to cool and reset, then retest.

⚠ WARNING

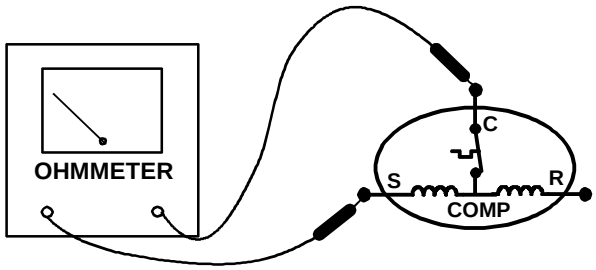
Disconnect Electrical Power Supply:

1. Remove the leads from the compressor terminals.

⚠ WARNING

SEE WARNING S-17 PAGE 66 BEFORE REMOVING COMPRESSOR TERMINAL COVER.

2. Using an ohmmeter, test continuity between terminals S-R, C-R, and C-S, on single phase units or terminals T2, T2 and T3, on 3 phase units.



TESTING COMPRESSOR WINDINGS

If either winding does not test continuous, replace the compressor.

NOTE: If an open compressor is indicated allow ample time for the internal overload to reset before replacing compressor.

S-17B Ground Test

If fuse, circuit breaker, ground fault protective device, etc., has tripped, this is a strong indication that an electrical problem exists and must be found and corrected. The circuit protective device rating must be checked and its maximum rating should coincide with that marked on the equipment nameplate.

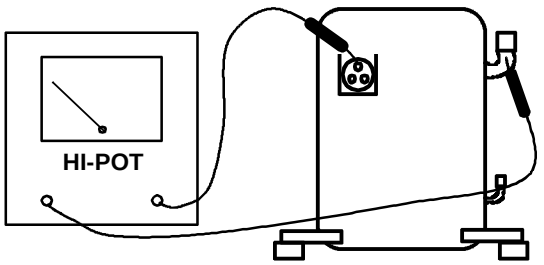
With the terminal protective cover in place, it is acceptable to replace the fuse or reset the circuit breaker ONE TIME ONLY to see if it was just a nuisance opening. If it opens again, DO NOT continue to reset.

Disconnect all power to unit, making sure that all power legs are open.

1. DO NOT remove protective terminal cover. Disconnect the three leads going to the compressor terminals at the nearest point to the compressor.

⚠ WARNING

DAMAGE CAN OCCUR TO THE GLASS EMBEDDED TERMINALS AT THIS POINT IF THE LEADS ARE NOT PROPERLY REMOVED, WHICH CAN RESULT IN THE TERMINAL VENTING AND HOT OIL DISCHARGING.



COMPRESSOR GROUND TEST

2. Identify the leads and using a Megger, Hi-Potential Ground Tester, or other suitable instrument which puts out a voltage between 300 and 1500 volts, check for a ground separately between each of the three leads and ground (such as an unpainted tube on the compressor). Do not use a low voltage output instrument such as a volt-ohmmeter.
3. If a ground is indicated, then carefully remove the compressor terminal protective cover and inspect for loose leads or insulation breaks in the lead wires.
4. If no visual problems indicated, carefully remove the leads at the compressor terminals.

   Carefully retest for ground, directly between compressor terminals and ground.
5. If ground is indicated, replace the compressor.

S-17C Operation Test

If the voltage, capacitor, overload and motor winding test fail to show the cause for failure:

⚠ WARNING

Disconnect Electrical Power Supply:

1. Remove unit wiring from disconnect switch and wire a test cord to the disconnect switch.

NOTE: The wire size of the test cord must equal the line wire size and the fuse must be of the proper size and type.

2. With the protective terminal cover in place, use the three leads to the compressor terminals that were disconnected at the nearest point to the compressor and connect the common, start and run clips to the respective leads.
3. Connect good capacitors of the right MFD and voltage rating into the circuit.
4. With power ON, close the switch.

⚠ WARNING

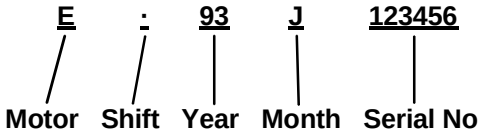
LINE VOLTAGE NOW PRESENT

A. If the compressor starts and continues to run, the cause for failure is somewhere else in the system.

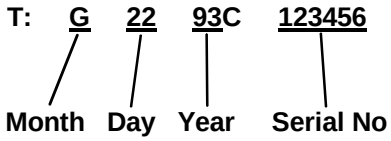
B. If the compressor fails to start - replace.

Compressor Serial Number Identification

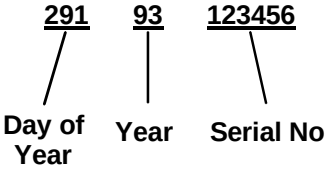
COPELAND COMPRESSOR



TECUMSEH COMPRESSOR



BRISTOL COMPRESSOR



S-18 TESTING CRANKCASE HEATER

The crankcase heater must be energized a minimum of four (4) hours before the condensing unit is operated.

Crankcase heaters are used to prevent migration or accumulation of refrigerant in the compressor crankcase during the off cycles and prevents liquid slugging or oil pumping on start up. Scroll Compressors are not equipped with a crankcase heaters.

A crankcase heater will not prevent compressor damage due to a floodback or over charge condition.

⚠ WARNING

Disconnect Electrical Power Supply:

1. Disconnect the heater lead wires.
2. Using an ohmmeter, check heater continuity - should test continuous, if not, replace.

NOTE: The positive temperature coefficient crankcase heater is a 40 watt 265 voltage heater. The cool resistance of the heater will be approximately 1800 ohms. The resistance will become greater as the temperature of the compressor shell increases.

S-21 CHECKING REVERSING VALVE AND SOLENOID

Occasionally the reversing valve may stick in the heating or cooling position or in the mid-position.

When stuck in the mid-position, part of the discharge gas from the compressor is directed back to the suction side, resulting in excessively high suction pressure. An increase in the suction line temperature through the reversing valve can also be measured. Check operation of the valve by starting the system and switching the operation from COOLING to HEATING cycle.

SERVICING

If the valve fails to change its position, test the voltage (24V) at the valve coil terminals, while the system is on the COOLING cycle.

If no voltage is registered at the coil terminals, check the operation of the reversing relay and the continuity of the connecting wires.

If voltage is registered at the coil, tap the valve body lightly while switching the system from HEATING to COOLING, etc. If this fails to cause the valve to switch positions, remove the coil connector cap and test the continuity of the reversing valve solenoid coil. If the coil does not test continuous - replace it.

If the valve is inoperative - replace it.

S-22 REVERSING VALVE REPLACEMENT

Remove the refrigerant charge from the system.

When brazing a reversing valve into the system, it is of extreme importance that the temperature of the valve **does not exceed 250°F**. at any time.

Wrap the reversing valve with a large rag saturated with water. "Re-wet" the rag and thoroughly cool the valve after each brazing operation of the four joints involved. The wet rag around the reversing valve will eliminate conduction of heat to the valve body when brazing the line connection.

The use of a wet rag sometimes can be a nuisance. There are commercial grades of heat absorbing paste that may be substituted.

After the valve has been installed, leak test, evacuate and recharge.

S-23 CHECKING DEFROST CONTROL BOARD

The Defrost Control Board is an electronic device which is not field repairable. If a malfunction should occur the complete board must be replaced. The board has anti-short cycle protection, high and low pressure switch interrupts incorporated into the control.

Normal sequence of operation, Cooling Mode.

1. If the compressor has been off for at least 3 minutes when a call for cool is received, the compressor is immediately energized. The indoor blower is energized at the cooling speed after a 7 second delay.
2. If the compressor has not been off for at least 3 minutes when a call for cooling is received, the control waits at least 3 minutes before energizing the compressor. The LED will flash 6 times when the compressor is delayed on the anti-short cycle timer.
4. If power to the control is interrupted, the compressor will be energized after a 3 minute delay after power is re-applied to the control. The control will flash 6 times to indicate the compressor is delayed on the anti-short cycle timer.
5. The control de-energizes the indoor blower 60 seconds after the call for cooling is removed.

This control has a self diagnostic feature. Before performing any test observe the LED indicators and compare to the chart below for board status.

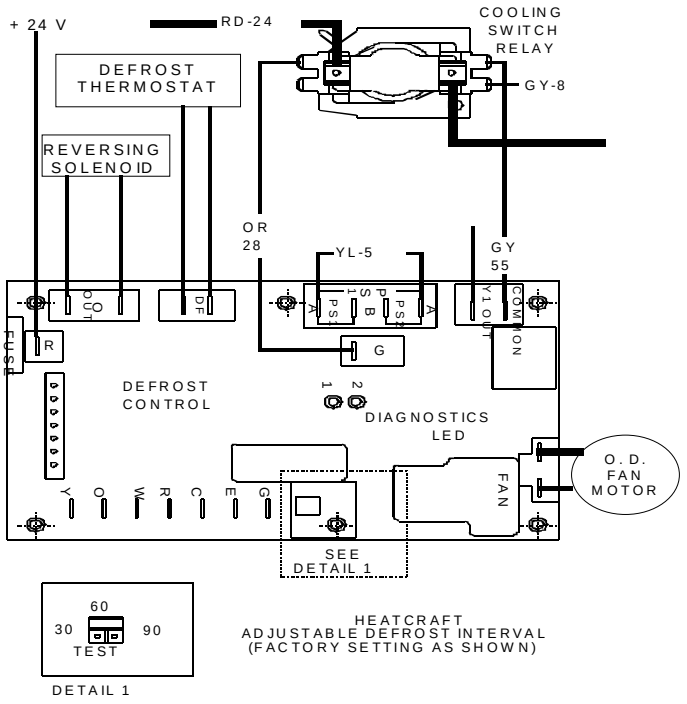
DIAGNOSTICS	LED 1	LED 2
NORMAL OPERATION	BOTH FLASHING	
SHORT CYCLE	ALTERNATING FLASHING	
LOCKOUT	ON	OFF
BOARD FAILURE	ON	ON

Normal sequence of operation, Heating Mode.

1. If the compressor has been off for at least 3 minutes when a call for heat is received, the compressor is immediately energized. The indoor blower is energized at the cooling speed after a 7 second delay.
2. If the compressor has not been off for at least 3 minutes when a call for heating is received, the control waits at least 3 minutes before energizing the compressor. The LED will flash 6 times when the compressor is delayed on the anti-short cycle timer.
4. If power to the control is interrupted, the compressor will be energized after a 3 minute delay after power is re-applied to the control. The control will flash 6 times to indicate the compressor is delayed on the anti-short cycle timer.

The following has been simplified in order to illustrate the Electronic functions:

5. When the defrost thermostat (30/60 control) closes (coil temperature at approximately 30°F.), the solid state board becomes programmed.



DEFROST CONTROL BOARD

NOTE: If the board is powered up with the jumper connected to the test pins, the board will ignore test and default to 90 minute time. If the jumper is left on the test connection for more than ten minutes, the board will ignore test jumper and default to 90 minute time. If jumper is missing, the board will default to 90 minute time.

6. Whenever the (CC) compressor contactor is energized, the solid state timer counts the compressor run time. Total accumulated minutes (run time) is retained as long as the Defrost (30/60) control stays closed. With the jumper connected to the 90 minute pins, the compressor run time is 90 minutes (factory wired). The board has jumper pin for 60 and 30 minute times as well. Timer count time may be accelerated for testing only, by placing jumper on test pins. (Example: 90 minutes = approximately 21 seconds). Remove the jumper when the board goes into defrost mode. If the jumper is not removed, the timer will remain accelerated through the defrost period.
7. At end of the programmed time, common circuit (C) is made to the (OUT) terminal. The reversing solenoid becomes energized and will stay energized until defrost (30/60) control opens by coil temperature, or after 10 minutes of run time. Maximum defrost time limited to 10 minutes compressor run time. During the defrost time, the board will apply power to the "W" terminal to bring on supplemental electric heat (if installed).
8. The control de-energizes the indoor blower 60 seconds after the call for heating is removed.

S-24 TESTING DEFROST BOARD

To check the defrost timer board for proper sequencing, proceed as follows: With power ON; unit not running.

1. Jumper defrost (30/60 control by placing a jumper wire across "DF" terminals.) terminal at defrost timer board.
2. Connect jumper across test pins on defrost control board.
3. Set thermostat to call for heating. System should go into defrost within 21 seconds.
4. Immediately remove jumper from test pins.
5. Using VOM check for voltage across OUT Terminals (BK-19 & BK-20). meter should read 24 volts.
6. Using VOM check for voltage across Fan terminals on the board (VT-62 & VT-16). You should read line voltage (208-230 VAC) indicating the relay is open in the defrost mode.
7. Using VOM check for voltage across "W & C" terminals on the board. You should read 24 volts.
8. If not as above, replace control board.
9. Set thermostat to off position and disconnect power before removing any jumpers or wires.

NOTE: Remove jumper across defrost thermostat and replace jumper to 30, 60, or 90 minute position before returning system to service.

S-25 TESTING DEFROST CONTROL (30°/60°)

1. Install a thermocouple type temperature test lead on the tube adjacent to the defrost control. Insulate the lead point of contact.
2. Check the temperature at which the control closes its contacts (30°F. ± 5°F.)
3. Raise the temperature of the control until opens

   (60°F. ± 5°F.)
4. If not as above, replace control.

S-50 CHECKING HEATER LIMIT CONTROL(S)

(OPTIONAL ELECTRIC HEATERS)

Each individual heater element is protected with an automatic rest limit control connected in series with each element to prevent overheating of components in case of low airflow. This limit control will open its circuit at approximately 150°F. and close at 110°F.

⚠ WARNING

Disconnect Electrical Power Supply:

1. Remove the wiring from the control terminals.
2. Using an ohmmeter test for continuity across the normally closed contacts. No reading indicates the control is open - replace if necessary.

IF FOUND OPEN - REPLACE - DO NOT WIRE AROUND.

S-52 CHECKING HEATER ELEMENTS

Optional electric heaters may be added, in the quantities shown in the specifications section to provide electric resistance heating. Under no condition shall more heaters than the quantity shown be installed.

The low voltage circuit in the blower section is factory wired and terminates at the location provided for the electric heater(s).

⚠ WARNING

Disconnect Electrical Power Supply:

1. Disassemble and remove the heating element.
2. Visually inspect the heater assembly for any breaks in the wire or broken insulators.
3. Using an ohmmeter, test the element for continuity - no reading indicates the element is open. Replace as necessary.

See "Electric Heater" in the Product Design Section (page 23) to verify heater amperage and temperature rise.

SERVICING

S-53 OUTDOOR TEMPERATURE CONTROL

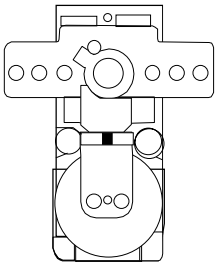
(OPTIONAL ITEM)

ATK01 This kit includes an ambient thermostat mounted in a weatherproof box for installation exterior to the unit. This kit is used for ambient control on all Amana package models and remote cooling models.

⚠ WARNING

Disconnect Electrical Power Supply:

1. Remove field connected low voltage wires from control terminals.
2. In ambient temperatures below 60°F, set the knob to correspond with the actual temperature of the control.
3. Using an ohmmeter, test for continuity between the control terminals. It should not test continuous. The control is designed to open at this point with a manual differential of approximately 4°F.
4. In ambient temperatures above 60°F., it will be necessary to chill the control.



OUTDOOR TEMPERATURE CONTROL

S-100 REFRIGERATION REPAIR PRACTICE

⚠ DANGER

ALWAYS REMOVE THE REFRIGERANT CHARGE IN A PROPER MANNER BEFORE APPLYING HEAT TO THE SYSTEM.

When repairing the refrigeration system:

1. Never open a system that is under vacuum. Air and moisture will be drawn in.
2. Plug or cap all openings.
3. Remove all burrs and clean the brazing surfaces of the tubing with sand cloth or paper. Brazing materials do not flow well on oxidized or oily surfaces.
4. Clean the inside of all new tubing to remove oils and pipe chips.
5. When brazing, sweep the tubing with dry nitrogen to prevent the formation of oxides on the inside surfaces.
6. Complete any repair by replacing the liquid line drier in the system, evacuate and charge.

At any time the system has been open for repair, a liquid line filter dryer must be installed. The dryer should be installed between the partition panel and the expansion device.

Heat pump models will require a bi-flow dryer.

BRAZING MATERIALS

Copper to Copper Joints - Sil-Fos used without flux (alloy of 15% silver, 80% copper, and 5% phosphorous). Recommended heat 1400°F.

Copper to Steel Joints - Silver Solder used without a flux (alloy of 30% silver, 38% copper, 32% zinc). Recommended heat - 1200°F.

S-101 LEAK TESTING

Refrigerant leaks are best detected with a halide or electronic leak detector.

However, on outdoor installed systems, provisions must be made to shield the copper element of an halide torch from the sun and wind conditions in order to be able to see the element properly.

NOTE: The flame of the halide detector will glow green in the presence of R-22 refrigerant.

For a system that contains a refrigerant charge and is suspected of having a leak, stop the operation and hold the exploring tube of the detector as close to the tube as possible, check all piping and fittings. If a leak is detected, do not attempt to apply more brazing to the joint. Remove and capture the charge, unbraze the joint, clean and rebraze.

For a system that has been newly repaired and does not contain a charge, connect a cylinder of refrigerant, through a gauge manifold, to the liquid and suction line dill valves and/or liquid line dill valve and compressor process tube.

NOTE: Refrigerant hoses must be equipped with dill valve depressors or special adaptor used. Open the valve on the cylinder and manifold and allow the pressure to build up within the system. Check for and handle leaks, as described above. After the test has been completed, remove and capture the leak test refrigerant.

S-102 EVACUATION

This is the most important part of the entire service procedure. The life and efficiency of the equipment is dependent upon the thoroughness exercised by the serviceman when evacuating air (non-condensable) and moisture from the system.

Air in a system causes high condensing temperature and pressure, resulting in increased power input and reduced performance.

Moisture chemically reacts with the refrigerant and oil to form corrosive hydrofluoric and hydrochloric acids. These attack motor windings and parts, causing breakdown.

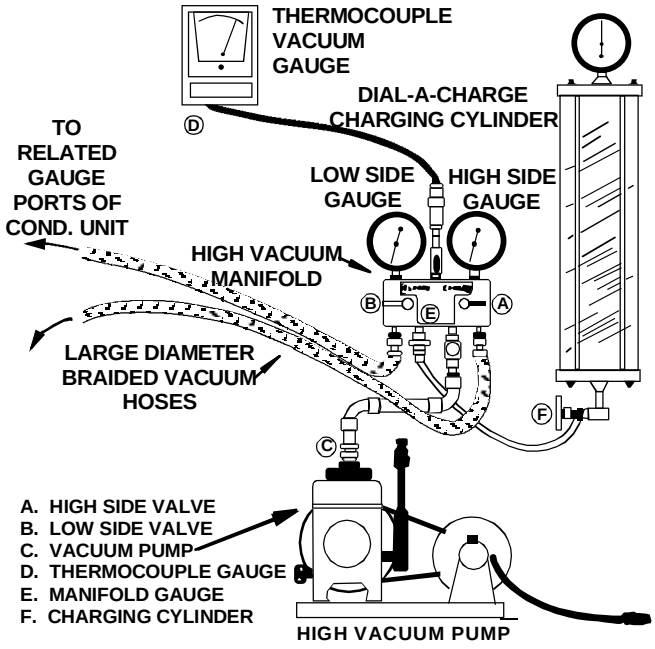
SERVICING

The equipment required to thoroughly evacuate the system is a high vacuum pump, capable of producing a vacuum equivalent to 25 microns absolute and a thermocouple vacuum gauge to give a true reading of the vacuum in the system.

NOTE: Never use the system compressor as a vacuum pump or run when under a high vacuum. Motor damage could occur.

⚠ WARNING

SCROLL COMPRESSORS: DO NOT FRONT SEAT THE SERVICE VALVE(S) WITH THE COMPRESSOR OPERATING IN AN ATTEMPT TO SAVE REFRIGERANT. WITH THE SUCTION LINE OF THE COMPRESSOR CLOSED OR SEVERALLY RESTRICTED, THE SCROLL COMPRESSOR CAN AND WILL DRAW A DEEP VACUUM VERY QUICKLY. THIS VACUUM CAN CAUSE INTERNAL ARCING OF THE FUSITE RESULTING IN A DAMAGED OR FAILED COMPRESSOR.



EVACUATION

1. Connect the vacuum pump, vacuum tight manifold set with high vacuum hoses, thermocouple vacuum gauge and charging cylinder as shown.
2. If the service dill valves are to be used for evacuation, it is recommended that a core remover be used to lift the core for greater efficiency.
3. Start the vacuum pump and open the shut off valve to the high vacuum gauge manifold only. After the compound gauge (low side) has dropped to approximately 29 inches of vacuum, open the valve to the vacuum thermocouple gauge. See that the vacuum pump will blank-off to a maximum of 25 microns. A high vacuum pump can only produce a good vacuum if its oil is non-contaminated.
4. If the vacuum pump is working properly, close the valve to the vacuum thermocouple gauge and open the high and low side valves to the high vacuum manifold set. With the valve on the charging cylinder closed, open the manifold valve to the cylinder.
5. Evacuate the system to at least 29 inches gauge before opening valve to thermocouple vacuum gauge.
6. Continue to evacuate to a minimum of 250 microns. Close valve to vacuum pump and watch rate of rise. If vacuum does not rise above 1500 microns in three to five minutes, system can be considered properly evacuated.
7. If thermocouple vacuum gauge continues to rise and levels off at about 5000 microns, moisture and non-condensables are still present. If gauge continues to rise a leak is present. Repair and re-evacuate.
8. Close valve to thermocouple vacuum gauge and vacuum pump. Shut off pump and prepare to charge.

S-103 CHARGING

Charge the system with the exact amount of refrigerant.

Refer to the specification section or check the unit nameplates for the correct refrigerant charge.

An inaccurately charged system will cause future problems.

1. When using an ambient compensated calibrated charging cylinder, allow liquid refrigerant only to enter the high side.
2. After the system will take all it will take, close the valve on the high side of the charging manifold.
3. Start the system and charge the balance of the refrigerant through the low side. DO NOT charge in a liquid form.
4. With the system still running, close the valve on the charging cylinder. At this time, you may still have some liquid refrigerant in the charging cylinder hose and will definitely have liquid in the liquid hose. Reseat the liquid line core. Slowly open the high side manifold valve and transfer the liquid refrigerant from the liquid line hose and charging cylinder hose into the suction service valve port. **CAREFUL:** Watch so that liquid refrigerant does not enter the compressor.
5. With the system still running, reseat the suction valve core, remove hose and reinstall both valve core caps.
6. Check system for leaks.

NOTE: THIS CHARGING PROCEDURE CAN ONLY BE DONE IN THE COOLING MODE OF OPERATION. ALL MODELS WITH COMPRESSOR PROCESS TUBE ACCESS VALVE CAN BE PROCESSED IN HEATING CYCLE IF THIS VALVE IS USED.

SERVICING

Units having capillary tubes or flow control restrictors can be checked against the Desired Superheat vs. Outdoor Temperature Chart in this section. Coils with thermostatic expansion valves (TXV's) must be checked by subcooling. See "Checking Subcooling and Superheat" sections in this manual.

If a restriction is located, replace the restricted part, replace drier, evacuate and recharge.

S-104 CHECKING COMPRESSOR EFFICIENCY

The reason for compressor inefficiency is broken or damaged suction and/or discharge valves, or scroll flanks on Scroll compressors, reducing the ability of the compressor to pump refrigerant vapor.

The condition of the valves or scroll flanks is checked in the following manner.

1. Attach gauges to the high and low side of the system.
2. Start the system and run a "Cooling Performance Test.

If the test shows-

⇒ Below normal high side pressure.

⇒ Above normal low side pressure.

⇒ Low temperature difference across coil.

⇒ Low amp draw at compressor.

-and the charge is correct. The compressor is faulty - replace the compressor. **NOTE:** THIS TEST CANNOT BE DONE IN THE HEATING MODE

S-105 THERMOSTATIC EXPANSION VALVE

The expansion valve is designed to control the rate of liquid refrigerant flow into an evaporator coil in exact proportion to the rate of evaporation of the refrigerant in the coil. The amount of refrigerant entering the coil is regulated since the valve responds to temperature of the refrigerant gas leaving the coil (feeler bulb contact) and the pressure of the refrigerant in the coil.

This regulation of the flow prevents the return of liquid refrigerant to the compressor.

The three forces which govern the operation of the valve are: (1) the pressure created in the power assembly by the feeler bulb, (2) evaporator pressure, and (3) the equivalent pressure of the superheat spring in the valve.

0% bleed type expansion valves are used on the indoor coils. The 0% valve will not allow the system pressures (High and Low side) to equalize during the shut down period. The valve will shut off completely at approximately 100 PSIG Pressure.

Good thermal contact between the feeler bulb and the suction line is essential to satisfactory valve control and performance.

The bulb must be securely fastened to a clean straight section of the suction line. Application of the bulb to a horizontal run of line is preferred. If a vertical installation cannot be avoided the bulb should be mounted so that the capillary tubing comes out at the top.

THE VALVES PROVIDED BY AMANA ARE DESIGNED TO MEET THE SPECIFICATION REQUIREMENTS FOR OPTIMUM PRODUCT OPERATION. **DO NOT USE SUBSTITUTES.**

S-106 OVERFEEDING

Overfeeding by the expansion valve results in high suction pressure, cold suction line, and possible liquid slugging of the compressor.

If these symptoms are observed:

1. Check for an overcharged unit by referring to the cooling performance charts in the servicing section.
2. Check the operation of the power element in the valve as explained in S-26 Checking Expansion Valve Operation.
3. Check for restricted or plugged equalizer tube.

S-107 UNDERFEEDING

Underfeeding by the expansion valve results in low system capacity and low suction pressures.

If these symptoms are observed:

1. Check for a restricted liquid line or drier. A restriction will be indicated by a temperature drop across the drier.
2. Check the operation of the power element of the valve as described in S-26 Checking Expansion Valve Operation.

S-108 SUPERHEAT

The expansion valves are factory adjusted to maintain 12 to 18 degrees superheat of the suction gas. Before checking the superheat or replacing the valve, perform all the procedures outlined under Air Flow, Refrigerant Charge, Expansion Valve - Overfeeding, Underfeeding. These are the most common causes for evaporator malfunction.

CHECKING SUPERHEAT

Refrigerant gas is considered superheated whenever its temperature is higher than the saturation temperature corresponding to its pressure. The degree of superheat equals the degrees of temperature increase above the saturation temperature at existing pressure. See Temperature - Pressure Chart.

1. Attach an accurate thermometer or preferably a thermocouple type temperature tester to the suction line at a point at least 6" from the compressor.
2. Install a low side pressure gauge on the suction line service valve at the outdoor unit.
3. Record the gauge pressure and the temperature of the line.

4. Convert the suction pressure gauge reading to temperature by finding the gauge reading in Temperature - Pressure Chart and reading to the left, find the temperature in the °F. Column.
5. The difference between the thermometer reading and pressure to temperature conversion is the amount of superheat.

EXAMPLE:

a. Suction Pressure = 84

b. Corresponding Temp. °F. = 50

c. Thermometer on Suction Line = 63°F.

To obtain the degrees temperature of superheat subtract 50.0 from 63.0°F.

The difference is 13° Superheat. The 13° Superheat would fall in the ± range of allowable superheat.

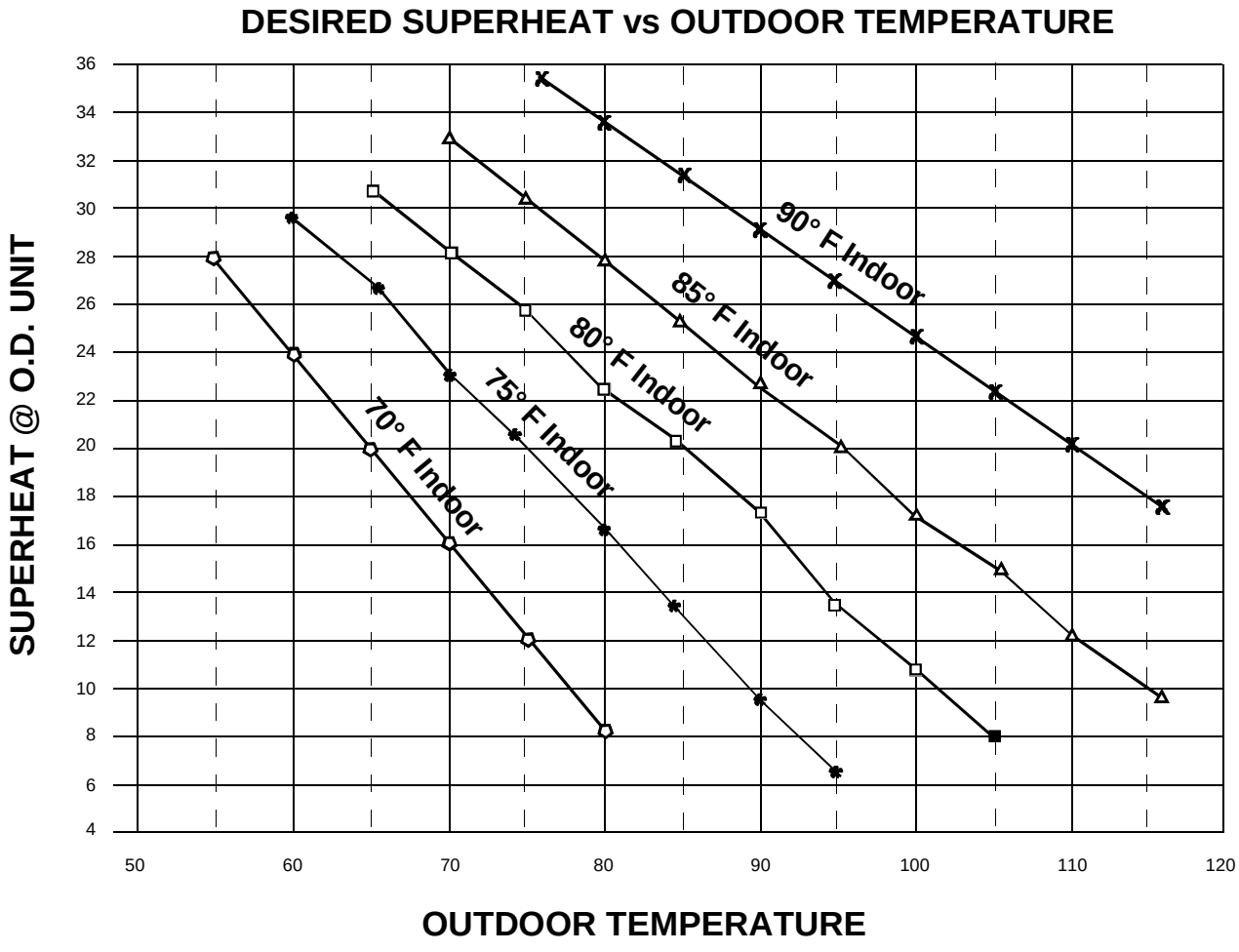
SUPERHEAT ADJUSTMENT

The expansion valves used on Amana coils are factory set and are not field adjustable. If the superheat setting becomes disturbed, replace the valve.

S-109 CHECKING SUBCOOLING

Refrigerant liquid is considered subcooled whenever its temperature is lower than the saturation temperature corresponding to its pressure. The degree of subcooling equals the degrees of temperature decrease below the saturation temperature at the existing pressure.

1. Attach an accurate thermometer or preferably a thermocouple type temperature tester to the liquid line as it leaves the condensing unit.
2. Install a high side pressure gauge on the high side service valve at the front of the unit.
3. Record the gauge pressure and the temperature of the line.
4. Convert the discharge pressure gauge reading to temperature by finding the gauge reading in Temperature - Pressure Chart and reading to the left, find the temperature in the °F. Column.
5. The difference between the thermometer reading and pressure to temperature conversion is the amount of subcooling.



EXAMPLE:

a. Discharge Pressure = 260

b. Corresponding Temp. °F. = 120°

c. Thermometer on Liquid line = 109°F.

To obtain the amount of subcooling subtract 109°F from 120°F.

TEMPERATURE - PRESSURE (R-22)

Temp. °F.	Gauge Pressure (PSIG) Freon-22	Temp. °F.	Gauge Pressure (PSIG) Freon-22
-40	0.61	60	102.5
-38	1.42	62	106.3
-36	2.27	64	110.2
-34	3.15	65	114.2
-32	4.07	68	118.3
-30	5.02	70	122.5
-28	6.01	72	126.8
-26	7.03	74	131.2
-24	8.09	76	135.7
-22	9.18	78	140.5
-20	10.31	80	145.0
-18	11.48	82	149.5
-16	12.61	84	154.7
-14	13.94	86	159.8
-12	15.24	88	164.9
-10	16.59	90	170.1
-8	17.99	92	175.4
-6	19.44	94	180.9
-4	20.94	96	186.5
-2	22.49	96	192.1
0	24.09	100	197.9
2	25.73	102	203.8
4	27.44	104	209.9
6	29.21	106	216.0
8	31.04	108	222.3
10	32.93	110	228.7
12	34.88	112	235.2
14	36.89	114	241.9
16	38.96	116	248.7
18	41.09	118	255.6
20	43.28	120	262.6
22	45.53	122	269.7
24	47.85	124	276.9
26	50.24	126	284.1
28	52.70	128	291.4
30	55.23	130	298.8
32	57.83	132	306.3
34	60.51	134	314.0
36	63.27	136	321.9
38	66.11	136	329.9
40	69.02	140	338.0
42	71.99	142	346.3
44	75.04	144	355.0
46	78.18	146	364.3
48	81.40	158	374.1
50	84.70	150	384.3
52	88.10	152	392.3
54	91.5	154	401.3
56	95.1	156	411.3
58	98.8	158	421.8
		160	433.3

The difference is 11° subcooling. The normal subcooling range is 9° - 13° subcooling for heat pumps units, 14° - 18° for cooling units and gas packs.

S-110 CHECKING EXPANSION VALVE OPERATION

1. Remove the remote bulb of the expansion valve from the suction line.
2. Start the system and cool the bulb in a container of ice water, closing the valve. As you cool the bulb the suction pressure should fall and the suction temperature will rise.
3. Next warm the bulb in your hand. As you warm the bulb the suction pressure should rise and the suction temperature will fall.
4. If a temperature or pressure change is notices, the expansion valve is operating. If no change is noticed, the valve is restricted, the power element is faulty, or the equalizer tube is plugged.
5. Remove the charge, replace the valve and drier, evacuate and recharge.

S-111 FIXED ORIFICE RESTRICTION DEVICES

The fixed orifice restriction device (flowrator) used in conjunction with the indoor and outdoor coils are a predetermined bore (I.D.).

It is designed to control the rate of liquid refrigerant flow into an evaporator coil.

The amount of refrigerant that flows through the fixed orifice restriction device is regulated by the pressure difference between the high and low sides of the system.

In the cooling cycle when the outdoor air temperature rises, the high side condensing pressure rises. At the same time, the cooling load on the indoor coil increases, causing the low side pressure to rise, but at a slower rate.

Since the high side pressure rises faster when the temperature increases, more refrigerant flows to the evaporator, increasing the cooling capacity of the system.

When the outdoor temperature falls, the reverse takes place. The condensing pressure falls, and the cooling loads on the indoor coil decreases, causing less refrigerant flow.

A strainer is placed on the entering side of the tube to prevent any foreign material from becoming lodged inside the fixed orifice restriction device.

If a restriction should become evident, proceed as follows:

1. Recover refrigerant charge.
2. Remove the orifice or tube strainer assembly and replace.
3. Replace liquid line drier, evacuate and recharge.

SERVICING

CHECKING EQUALIZATION TIME

During the "OFF" cycle, the high side pressure bleeds to the low side through the fixed orifice restriction device. Check equalization time as follows:

1. Attach a gauge manifold to the suction and liquid line dill valves.
2. Start the system and allow the pressures to stabilize.
3. Stop the system and check the time it takes for the high and low pressure gauge readings to equalize.

If it takes more than seven (7) minutes to equalize, the restriction device is inoperative. Replace, install a liquid line drier, evacuate and recharge.

S-112 CHECKING RESTRICTED LIQUID LINE

When the system is operating, the liquid line is warm to the touch. If the liquid line is restricted, a definite temperature drop will be noticed at the point of restriction. In severe cases, frost will form at the restriction and extend down the line in the direction of the flow.

Discharge and suction pressures will be low, giving the appearance of an undercharged unit. However, the unit will have normal to high subcooling.

If a restriction is located, replace the restricted part, replace drier, evacuate and recharge.

S-113 OVERCHARGE OF REFRIGERANT

An overcharge of refrigerant is normally indicated by an excessively high head pressure.

An evaporator coil, using an expansion valve metering device, will basically modulate and control a flooded evaporator and prevent liquid return to the compressor.

An evaporator coil, using a fixed orifice metering device, could allow refrigerant to return to the compressor under extreme overcharge conditions. Also with a fixed orifice metering device, extreme cases of insufficient indoor air can cause icing of the indoor coil and liquid return to the compressor, but the head pressure would be lower.

There are other causes for high head pressure which may be found in the "Service Problem Analysis Guide."

If other causes check out normal, an overcharge or a system containing non-condensables would be indicated.

If this is observed:

1. Start the system.
2. Remove small quantities of gas from the suction line dill valve until the head pressure is reduced to normal.
3. Observe the system while running a cooling performance test, if a shortage of refrigerant is indicated, then the system contains non-condensables.

S-114 NON-CONDENSABLES

If non-condensables are suspected shut down the system and allow the pressures to equalize, wait at least 15 minutes. Compare the pressure, to the temperature of the coldest coil since this is where most of the refrigerant will be. If the pressure indicates a higher temperature than that of the coil temperature, non-condensables are present.

Non-condensables are removed from the system by first removing the refrigerant charge, replacing and/or installing liquid line drier, evacuate and recharging.

S-115 COMPRESSOR BURNOUT

When a compressor burns out, high temperature develops causing the refrigerant, oil and motor insulation to decompose forming acids and sludge.

If a compressor is suspected of being burned-out, attach a refrigerant hose to the liquid line dill valve and properly remove and dispose of the refrigerant.

Now determine if a burn out has actually occurred. Confirm by analyzing an oil sample using a Sporlan Acid Test Kit, AK-3 or its equivalent.

Remove the compressor and obtain an oil sample from the suction stub. If the oil is not acidic, either a burnout has not occurred or the burnout is so mild that a complete cleanup is not necessary.

If acid level is unacceptable the system must be cleaned by using the cleanup drier method.

⚠ CAUTION

DO NOT ALLOW THE SLUDGE OR OIL TO CONTACT THE SKIN, SEVERE BURNS MAY RESULT.

NOTE: The Flushing Method using R-11 refrigerant is no longer approved by Amana Refrigeration, Inc.

Suction Line Drier Clean-Up Method

Use AMANA part number **R0157057** Suction Line Drier Clean-Up Kit (41 cubic inches). This drier should be installed as close to the compressor as possible, either in a vertical or horizontal position. It may be necessary to use new tubing and form as required.

In all applications, the drier inlet must be above the drier outlet to provide proper oil return to the compressor.

NOTE: At least twelve (12) inches of the suction line immediately out of the compressor stub must be discarded due to burned residue and contaminates.

1. Remove compressor discharge line strainer, liquid line strainer and/or dryer and capillary tubes from indoor and outdoor coils.
2. On an expansion valve coil, remove the liquid line drier and expansion valve.
3. Purge all remaining components with dry nitrogen or carbon dioxide until clean.

4. Install new components including liquid liner drier.
5. Install suction line drier.
6. Braze all joints, leak test, evacuate, and recharge system.
7. Start up the unit and record the pressure drop across the cleanup drier.
8. Continue to run the system for a minimum of twelve (12) hours and recheck the pressure drop across the drier. Pressure drop should not exceed 6 - 8 PSIG.
9. Continue to run the system for several days repeatedly checking pressure drop across the suction line drier. If the pressure drop never exceeds the 6 - 8 PSIG, the drier must be adequate and is trapping the contaminants and it is permissible to leave it in the system.
10. If the pressure drop becomes greater, then it must be replaced and steps 5 through 9 repeated until it does not exceed 6 - 8 PSIG.

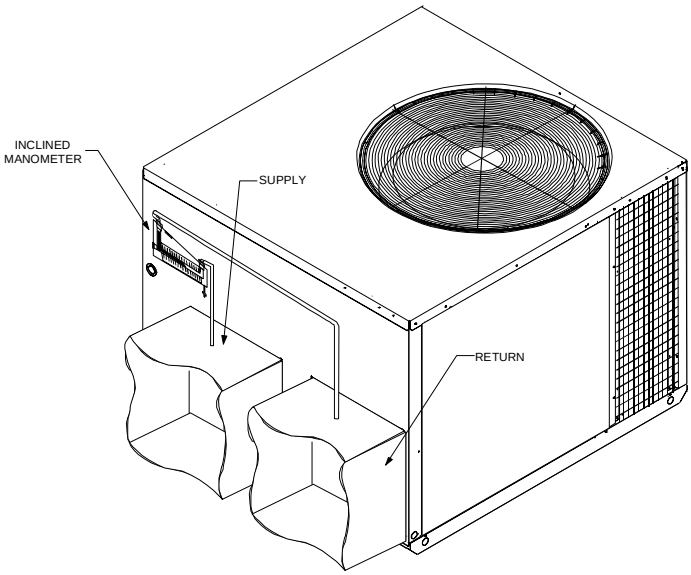
NOTICE: Regardless, the cause for burnout must be determined and corrected before the new compressor is started.

S-201 CHECKING EXTERNAL STATIC PRESSURE

The minimum and maximum allowable duct static pressure is found in the specification section.

Too great of an external static pressure will result in insufficient air that can cause icing of the coil, whereas too much air can cause poor humidity control, and condensate to be pulled off the evaporator coil causing condensate leakage. Too much air can cause motor overloading and in many cases this constitutes a poorly designed system. To determine proper air movement, proceed as follows:

1. Using a draft gauge (inclined manometer) measure the static pressure of the return duct at the inlet of the unit, (Negative Pressure).



TOTAL EXTERNAL STATIC

2. Measure the static pressure of the supply duct, (Positive Pressure).
3. Add the two readings together.

NOTE: Both readings may be taken simultaneously and read directly on the manometer if so desired.

4. Consult proper table for quantity of air.

If the external static pressure exceeds the minimum or maximum allowable statics, check for closed dampers, dirty filters, undersized or poorly laid out ductwork.

S-202 ECM/ICM Motors

ECM/ICM Features

Many of the Amana high efficiency package units incorporate the GE© ICM or variable speed blower motors for greater efficiency. ECM/ICM motors vary the motor RPMs to provide a set volume of air over a wide range of conditions.

ECM/ICM Control Connections

Control functions (G, Y1, Y2) May be Active at less than 1/2 control voltage. (i.e. 12 volts). Relay contacts on control functions must reliably switch low currents (less than 5 MA). Some thermostats (with triac switches) and Solid State Relays may allow enough "leakage" current to Turn on "G". Thermostats that "steal" power thru "Y" or other functions are not compatible.

The ECM control interface can be as simple as a direct connection to the thermostat. For example: R to G will cause fan to come at "fan-only" cfm. R to G to Y will cause fan to come on at cooling speed. The ECM/ICM control requires a common connection from the transformer (transformer common to C1, C2 on control). In typical applications C1 and C2 will be tied together. Additional features can be utilized with an interface control board (speed tap board), these features include; 2 Cool CFMs, 2 Dehumidification CFMs, 2 Heat CFMs, emergency heat CFM, separate Fan-Only CFM, and feed back information (CFM demand).

Testing ECM/ICM Motors

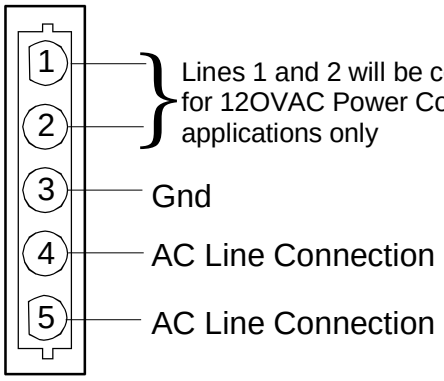
ECM/ICMs connect directly to the Line. **DO NOT** Insert Contactors in Series with the ECM/ICM Motor AC line. Control is powered continuously to Insure reliable start-up. Plug is polarized, verify and reverify correct connector orientation before applying power. **DO NOT** force plug into motor and make sure power is off before inserting power connector. **DO NOT** apply voltage to terminals 1 or 2.

SERVICING

WARNING

LINE VOLTAGE NOW PRESENT

Check for line voltage on terminals 4 and 5. Verify terminal 3 is ground. Terminals 1 and 2 should be connected **only** if motor is operating on 120 Volts.



POWER CONNECTOR

"Motor Half"

Control connections

Do not apply 24 volts to terminals "Out +" or "Out-".

Make sure connector is fully seated.

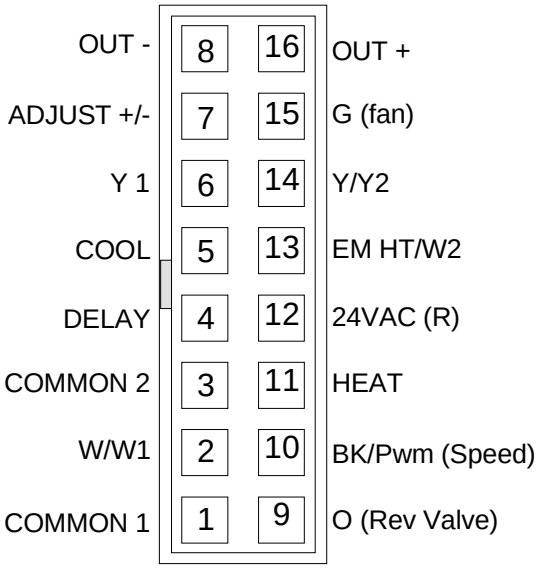
Make Sure Pins are Fully Seated in Connector Housing.

Verify C1 and C2 are connected to transformer common.

Verify "R" is connected to transformer hot.

After verifying above connections, motor can be tested by applying 24 volts to control pins. Example: R to G will cause fan to come at "Fan-Only" CFM. R to G to Y will cause fan to come on at cooling speed.

If motor does not respond as noted, ECM control unit is bad and should be replaced.



CONTROL CONNECTOR

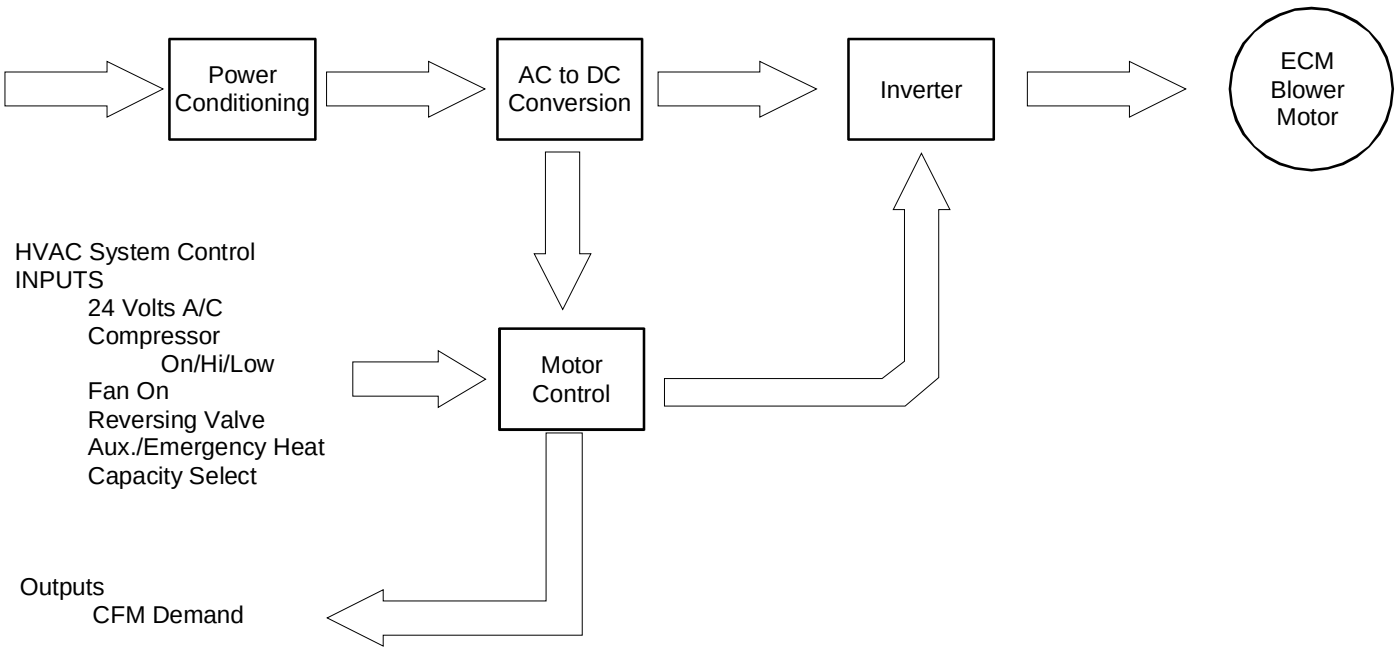
"Motor Half"

CAUTION

High Voltage on Control Pins will Destroy Motor

Replacing ICM Control Module

Use the following steps to replace the control module for the GE© variable speed indoor blower motor.



ICM/ECM CONTROL FLOW CHART

SERVICING

1. You must have the correct replacement module. The controls are factory programmed for specific operating modes. Even though they look alike, different modules may have completely different functionality. Using the wrong control module voids all product warranties and may produce unexpected results.
2. Remove all power from the unit being serviced. Do not work on the motor with power applied. Wait at least 5 minutes after disconnecting power from the equipment before opening the motor.
3. It is usually not necessary to remove the motor from the blower assembly. However it is recommended that the whole blower assembly, with the motor, be removed. Unplug the two cable connectors to the motor. There are latches on each connector. Do not pull on the wires. The plugs remove easily when properly released.
4. Observe the flat end of the motor control module casting and located the two standard ¼" hex head bolts. Remove these bolts from the motor while holding the control module. **Do not remove the two torx head screws**.
5. The control module is now free of the motor but still attacked by a plug and cable. Carefully rotate the control so as to gain access to the plug on the end of the cable. Squeeze the release latch and gently pull the plug out of the control module. Do not pull on the wires. Grip the plug only.
6. The control module is now completely detached from the motor. Verify with a standard ohmmeter that the resistance from each motor lead (in the motor plug just removed) to the motor shell is greater than 100k ohms. (Measure resistance to unpainted motor end plate). If any motor lead fails this test do not proceed to install the control module. The motor is defective and must be replaced. Installing the new control module will cause it to fail also.
7. Verify that the replacement control module is correct for your application. If so, orient the new module next to the motor and carefully insert the plug removed in step 5. Be sure the plug latches. It will click when properly inserted.
8. Install the new control module back on the motor being careful to engage the locating pin into the appropriate mating motor hole. Replace the two 1/4" hex head bolts. Tighten the bolts snugly. It is not necessary to overtighten.

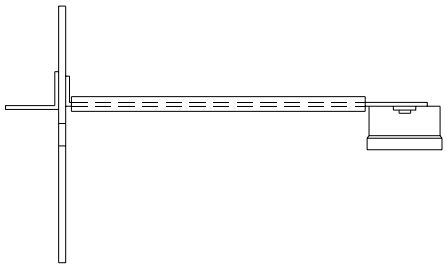
Note: Before replacing the blower/motor assembly, it is important to look at the installation to see if some application fault has caused the motor to fail.

Is there any evidence of water damage to the failed control? (Corrosion on the inside or outside of the casting.) If yes, do moisture check.

9. Re-install the blower/motor assembly into the package unit.
10. Plug the 16-pin control plug into the motor. The plug is keyed. Make sure the connector is properly seated and latched.
11. Plug the 5 pin power connector into the motor even though the plug is keyed, observe the proper orientation. Do not force the connector. It plugs in very easily when properly oriented. **Reversing this plug will cause immediate failure of the control module**.
12. Final installation check. Make sure the motor is installed as follows:
    A. As far into the blower housing as possible
    B. Belly bands not covering vent holes or on the control module
    C. Motor connectors should oriented as to prevent the accumulation of moisture in the control.
    D. Use wire ties to create a drip loop in the motor cables.
13. The installation is now complete. Reapply power to the package unit and verify that the new motor control module is working properly.

S-300 TESTING PRIMARY LIMIT CONTROL

Amana Package Gas Units use a snap-disk type primary limit device. Sometimes referred to as "stat on a stick". The limit setting is fixed and must not be readjusted in the field.



THERMODISC (TOD) LIMIT CONTROL

Refer to the specification section to determine the proper limit cutout temperature for the model being serviced.

In all instances the limit control is wired in series with the ignition control.

If the temperature within the furnace should exceed this setting, the control will open, de-energizing the ignition control which in turn will open the electrical circuit to the gas valve.

The control will automatically reset when the temperature within the combustion chamber is sufficiently lowered.

⚠ WARNING

Disconnect Electrical Power Supply:

1. Remove electrical power to unit. Some units may have more than one source of power.
2. Remove the wires from the limit control terminals.
3. Using an ohmmeter, test for continuity across the two terminals.

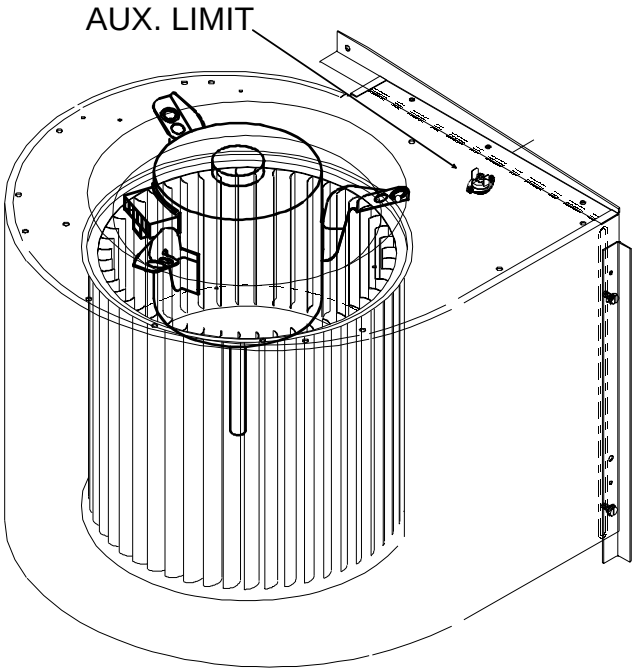
4. If limit test open allow unit to cool and retest.
5. If still open, replace the control.

S-301 TESTING AUXILIARY LIMIT

CONTROL This control is preset nonadjustable control mounted in the blower compartment area.

It is connected in series with the limit control wiring to the ignition control. If its temperature should be exceeded, it will open, interrupting the voltage to the gas valve causing it to open.

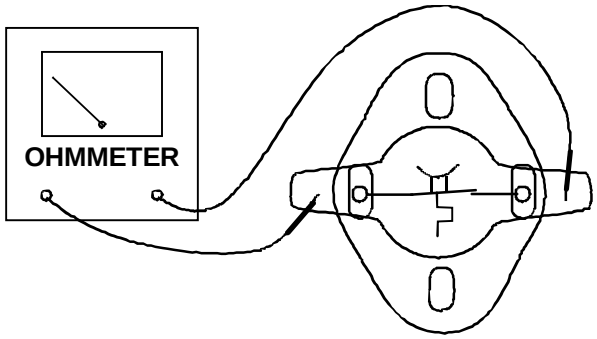
An additional limit (primary limit) control is required for safety control of high temperature within the furnace or duct work.



WARNING

Disconnect Electrical Power Supply:

1. Remove the wires from the auxiliary limit control terminals.
2. Using an ohmmeter, test for continuity across the two terminals. No reading indicates the control is open. Push the red reset button, test again - if still open, replace the control.



LIMIT OR AUXILIARY LIMIT CONTROL

S-302 CHECKING FLAME ROLLOUT SWITCH

Package Gas Units with serial numbers beginning 9001 and later use a temperature activated manual reset control mounted to the manifold assembly.

This control is wired in series with the primary limit and integrated control. The control is designed to open should a flame roll out occur. An over firing condition or flame impingement on the heat shield may also cause the control to open.

If the rollout control has opened, the circuit between the ignition control and gas valve will be interrupted and the ignition control module will go into lockout. The servicer should reset the ignition control by opening and closing the thermostat circuit. The servicer should look for the ignitor glowing which indicates there is power to the ignition control. The servicer should measure the voltage between each side of the rollout control and ground while the ignition control is try to power the gas valve.

Limit Switch Operation (Applies to Primary, Auxiliary, and Roll Out Limits) DSI systems.

If a limit switch opens, the indoor blower is energized on heat speed and the induced draft blower is energized. The LED on the control flashes "4" to indicate an open limit switch. The blower and inducer remain on while the limit switch is open. The gas valve is de-energized. Power to the thermostat "R" is removed while the limit switch is open.

When the limit switch re-closes, the induced draft motor runs through its post purge and the indoor blower goes through the heat off delay.

If a call for heat exists when the limit switch re-closes, the control goes through a pre-purge period and then makes an ignition attempt. The indoor blower remains on (for the delay off time) during the re-ignition attempt.

a. If no voltage is measured on either side of control it indicates ignition control or wiring to control problem.
b. If voltage is measured on one side of the control and not the other, it indicates the control is open.
c. If voltage is measured on both sides of the control the wiring to gas valve or valve is at fault.

Servicing procedure with furnace not firing.

1. Confirm that the outer door was in place and all screws tightened. (No leaks under the door.)
2. Check to see if any damage was done to the furnace especially the wiring.
3. Confirm that heat exchanger is not obstructed by feeling for discharge air from the flue hood when the combustion blower is running but the unit is not firing.

If the above steps do not suggest the reason the control has tripped the furnace should be fired.

1. Remove the heating compartment door.
2. Turn of the power or open the thermostat circuit.

3. Reset the roll-out control.
4. Turn power on and put the unit into a call for heating.

CAUTION

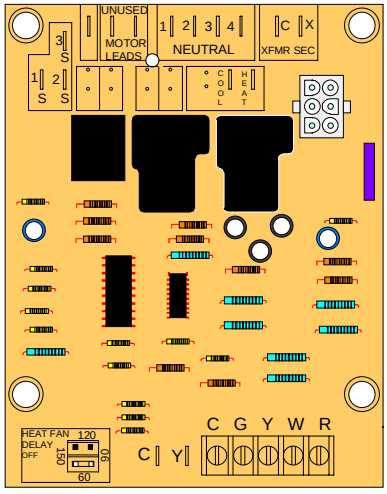
Assume flame roll-out could occur. Keep face and hands a safe distance from burner area.

5. Look under the heat shield as the unit is running. Flames should be drawn into firing tubes.
   A. If only one burners flame is not drawn into the tube, that tube is restricted.
   B. If with out the air circulation blower running, all flames are not drawn into the tubes either the collector box, combustion blower, or flue outlet is obstructed. If the combustion blower or flue outlet is obstructed, the pressure switch should have opened preventing the unit from firing, also inspect the unit pressure switch and wiring.
   C. If the burner flame is not drawn into the tube only when the air circulation blower is running, then a cracked heat exchanger tube is present.

S-304 TESTING GAS VALVE

Smart Valve Systems

Amana package units utilize Honeywell "Smart Valve" gas valves which provides all manual and automatic control functions required for gas fired heating equipment.



SMART VALVE FAN TIMER BOARD

NORMAL SEQUENCE OF OPERATION

1. Thermostat calls for heat. The combustion blower is immediately energized.
2. The pressure switch contacts transfer.
3. The ignitor is energized and pilot gas begins to flow.
4. After pilot flame is proven, the main valve is energized and the pilot will light the main burners.
5. The control checks the signal from the flame sensor. Gas flow will continue only if a proper signal is present. As soon as pilot flame is proven, the ignitor is de-energized.
6. The unit will continue to fire for 30 seconds. The fan control will then start the main circulating air blower.
7. The unit will deliver heat to the conditioned space until the thermostat is satisfied.
8. The gas valve and combustion blower will be de-energized when the thermostat opens.
9. There is an adjustable Heat Fan OFF of approximately 60/90/120/150 second delay (factory set at 120). The control module (figure 6) will de-energize the blower once the selected time has elapsed. This allows any additional heat in the heat exchanger to be transferred to the conditioned space.

RESET AFTER CONTROL LOCKOUT

Amana PGA__C, PGB__C and PGD__C units built prior to July, 1999, are equipped with the Honeywell "Smart Valve" system. If the control senses a loss of flame, the control will automatically attempt to relight. A lockout occurs only when the ignitor fails, roll-out switch, primary limit or secondary limit opens. This causes the air circulation blower to run continuously, and ignition is no longer attempted. When this occurs, it may be necessary to reset the control by turning the thermostat setting below room temperature for several seconds and then returning the setting to the desired temperature. The roll-out and secondary limit are manual reset switches and require resetting before normal operation can continue. A failed ignitor will require replacement. The control may also be reset after a lockout by turning off the electrical disconnect switch to the furnace for several seconds.

IMPORTANT: If the furnace frequently has to be reset, it means that a problem exists that should be corrected.

WARNING

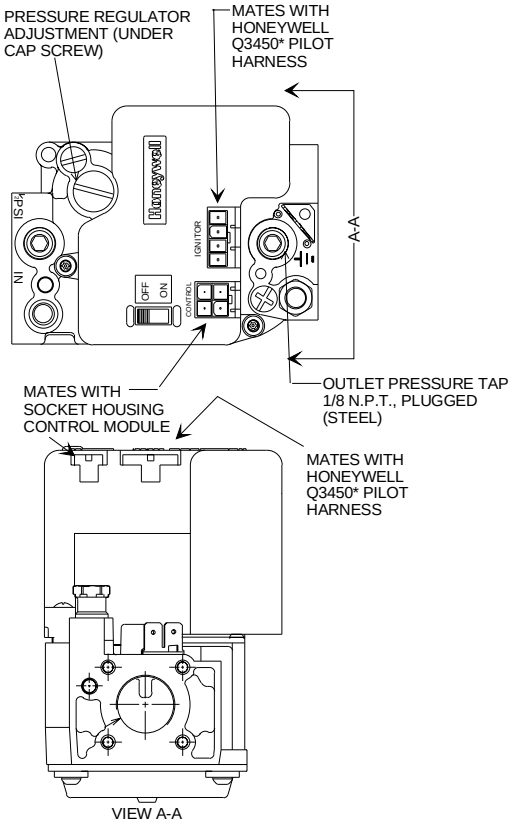
Disconnect Electrical Power Supply:

1. Remove wire connections from gas valve terminals.
2. Using an ohmmeter, test across the ignitor terminals, (Terminals 1 & 2 on the Q3450 harness)
3. Should read continuity, if not replace ignitor.
4. Using an ohmmeter, test from flame sensor to ground on the Q3450 harness.
6. If continuity is shown, replace pilot assembly.
7. Reconnect harness(es) to gas valve.
8. Restore power to unit.

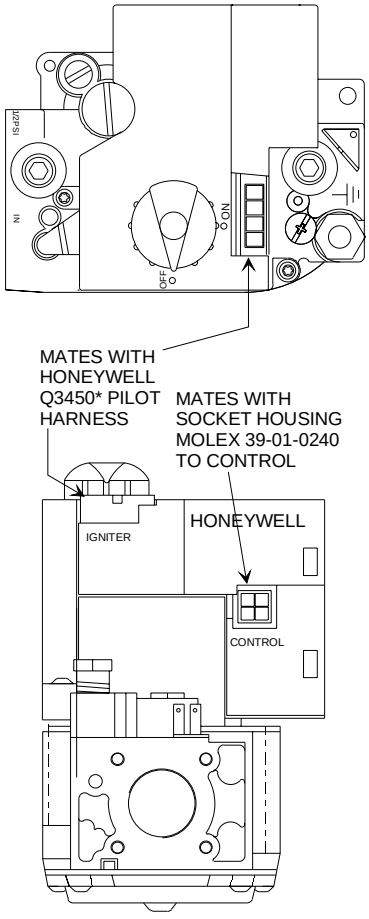
WARNING

Voltage Now Present

9. Set thermostat to demand for heat.


PRESSURE REGULATOR ADJUSTMENT (UNDER CAP SCREW)
MATES WITH HONEYWELL Q3450* PILOT HARNESS
A-A
OUTLET PRESSURE TAP 1/8 N.P.T., PLUGGED (STEEL)
MATES WITH SOCKET HOUSING CONTROL MODULE
MATES WITH HONEYWELL Q3450* PILOT HARNESS
VIEW A-A

HONEYWELL MODEL SV9500



HONEYWELL MODEL SV9501

10. Ignitor warn up is 5 Seconds. Amp draw to ignitor is 1 to 1.5 amps at 24 VAC. Use an Amprobe to verify current.
11. Using a microamp meter verify flame sense. Microamp readings should be 0.3 microamps or greater.
12. Smart Valve will not allow main burner operation until pilot is proven. NOTE: pilot positioning will affect pilot operation and flame sensing characteristics. See S-314 for proper pilot positioning.
13. If pilot looses flame sense, valve will shut off main burners and attempt relight. The "Smart Valve" system will not lock out from no flame sense, it will continue to attempt relight.

Direct Spark Ignition (DSI) Systems

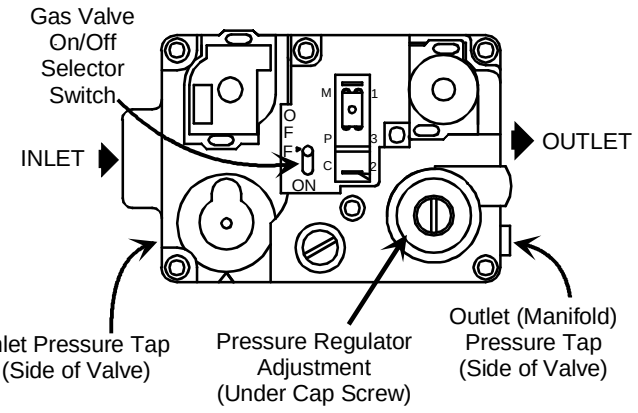
A combination redundant operator type gas valve which provides all manual and automatic control functions required for gas fired heating equipment is used.

The valve provides control of main burner gas flow, pressure regulation, and 100 percent safety shut-off.

⚠ WARNING

Disconnect Electrical Power Supply:

1. Remove wire connections from gas valve terminals.
2. Using an ohmmeter, test across the gas valve coil terminals, both the redundant and the main valve.



WHITE ROGERS MODEL 36E GAS VALVE

3. Should read approximately 130 Ohms for the Robertshaw main valve operator coils. The redundant coil will vary somewhat as well.
4. Reverse leads. Some redundant coils have (dividers) diodes.

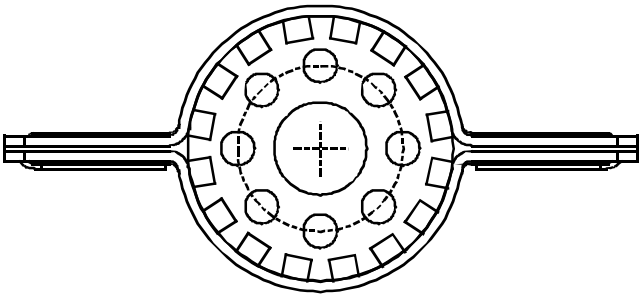
If not as above, replace the entire valve.

S-305 CHECKING MAIN BURNERS

The main burners are used to provide complete combustion of various fuels in a limited space, and transfer this heat of the burning process to the heat exchanger.

SERVICING

Proper ignition, combustion, and extinction are primarily due to burner design, orifice sizing, gas pressure, primary and secondary air, vent and proper seating of burners.



BECKETT BURNER

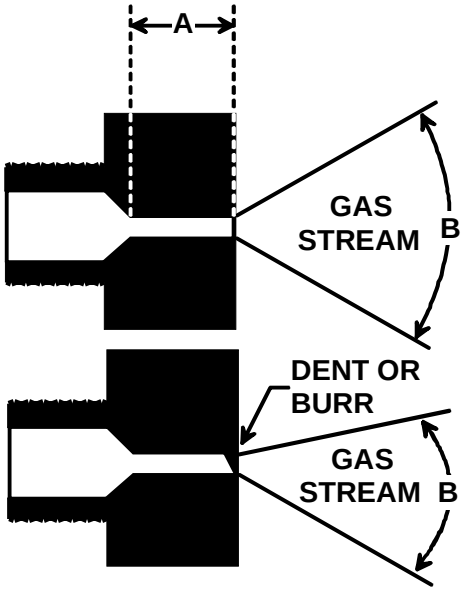
WARNING

Disconnect Gas and Electrical Power Supply:

In checking main burners, look for signs of rust, oversized and undersized carry-over ports restricted with foreign material, etc .

S-306 CHECKING ORIFICES

A predetermined fixed gas orifice is used in all of these furnaces. That is an orifice which has a fixed bore and position.



The length of Dimension "A" determines the angle of Gas Stream Defraction,"B".

A dent or burr will cause severe deflection of gas stream.

No resizing should be attempted until all factors are taken into consideration such as inlet manifold gas pressure, alignment, and positioning, specific gravity and BTU content of the gas being consumed.

The only time resizing is required is when a reduction in firing rate is required for an increase in altitude.

Orifices should be treated with care in order to prevent damage. They should be removed and installed with a box-end wrench in order to prevent distortion. In no instance should an orifice be peened over and redrilled. This will change the angle or deflection of the vacuum effect or entraining of primary air, which will make it difficult to adjust the flame properly. This same problem can occur if an orifice spud of a different length is substituted.

WARNING

Disconnect Gas and Electrical Power Supply:

1. Check orifice visually for distortion and/or burrs.
2. Check orifice size with orifice sizing drills.
3. If resizing is required, a new orifice of the same physical size and angle with proper drill size opening should be installed.

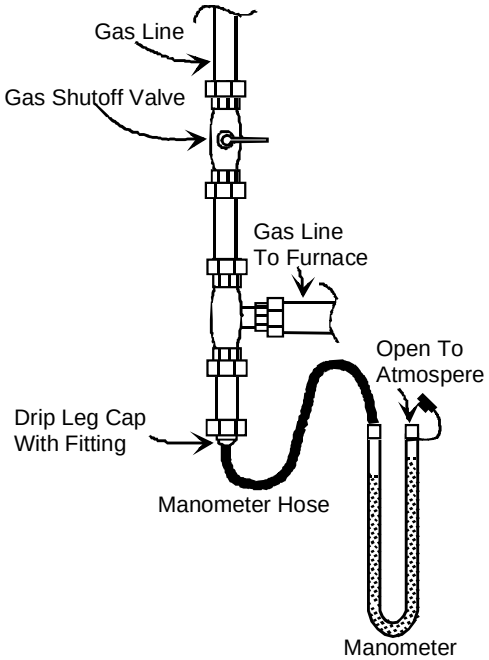
S-307 CHECKING GAS PRESSURE

Gas inlet and manifold pressures should be checked and adjusted in accordance to the type of fuel being consumed.

WARNING

Disconnect Gas and Electrical Power Supply:

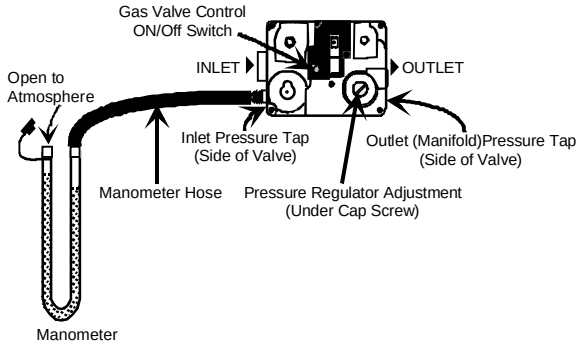
1. Connect a water manometer or adequate gauge upstream of the gas valve. (If no provisions are provided, we suggest removing cap from dripleg and install a predrilled cap with hose fitting as shown below.)



MEASURING INLET GAS PRESSURE

2. Remove the pressure tap fitting at the manifold if provided or from the gas valve and install fitting to connect another manometer or gauge.

SERVICING



MEASURING MANIFOLD GAS PRESSURE

With Power ON:

WARNING

LINE VOLTAGE NOW PRESENT.

3. Put furnace into heating cycle and turn on all other gas consuming appliances.

For **NATURAL GAS:**

a. Inlet pressure should be a nominal 7" w.c.

b. Manifold pressure should be 3.5 ± .3"w.c.

(Canadian - Sea Level 4.2" ± .3" w.c.)

For **PROPANE GAS:**

a. Inlet pressure should be a nominal 11" w.c.

b. Manifold pressure should be a nominal 10" w.c.

If operating pressures differ from above, make necessary pressure regulator adjustments, check piping size, etc., and/or consult with local utility.

S-308 CHECKING FOR DELAYED IGNITION

Delayed ignition is a delay in lighting a combustible mixture of gas and air which has accumulated in the combustion chamber.

When the mixture does ignite, it may explode and/or rollout causing burning in the burner venturi.

If delayed ignition should occur, the following should be checked:

1. Improper gas pressure - adjust to proper pressure. (See S-307)
2. Improper burner positioning - burners should be in locating slots, level front to rear and left to right.
3. Carry over (lighter tube or cross lighter) obstructed - clean.
4. Main burner orifice(s) deformed, or out of alignment to burner - replace.

S-309 CHECKING FOR FLASHBACK

Flashback will also cause burning in the burner venturi, but is caused by the burning speed being greater than the gas-air flow velocity coming from a burner port.

Flashback may occur at the moment of ignition, after a burner heats up or when the burner turns off. The latter is known as extinction pop.

Since the end results of flashback and delayed ignition can be the same (burning in the burner venturi) a definite attempt should be made to determine which has occurred.

If flashback should occur, check for the following:

1. Improper gas pressure - adjust to proper pressure. See S-**307**.
2. Check burner for proper alignment and/or replace burner.
3. Improper orifice size - check orifice for obstruction.

S-310 CHECKING PRESSURE CONTROL

A pressure control device is used to measure negative pressure at the induced draft blower motor inlet to detect a partial or blocked flue.

Pressure Switch Operation (Honeywell Smart Valve System)

The pressure switch is ignored unless there is a call for heat. When the control receives a call for heat, power for the smart valve is routed through the pressure switch (wires VT-18 - YL-11). The valve is not energized until the pressure switch is closed. If at any time the pressures opens power to the gas valve is removed. The inducer motor will continue to run as long as there is a call for heat at the thermostat.

Pressure Switch Operation (DSI Direct Spark System)

The pressure switch is ignored unless there is a call for heat. When the control receives a call for heat, the control checks to see that the pressure switch is open. If the control sees that the pressure switch is closed before the induced draft blower is energized, the LED will flash a code of "3" (to indicate the pressure switch is stuck closed) and the inducer will remain off until the pressure switch opens.

If the pressure switch opens before the ignition period, the induced draft blower will remain on and the control will stay in pre-purge until the pressure switch is closed for an entire 15 second pre-purge period. The LED will flash a code of "2" to indicate open pressure switch.

If the pressure switch opens after the gas valve has been energized, the control will de-energize the gas valve and run the indoor blower through the heat off delay. The inducer stays on until the pressure switch re-closes. Then the control makes another ignition attempt.

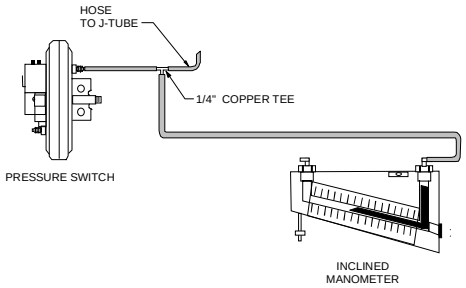
WARNING

Disconnect Electrical Power Supply:

1. Remove wires from the electrical terminals.
2. Using a VOM check from Common to NO (Normally Open) - should read open.

If switch reads as noted proceed to Step 3, otherwise replace control.

3. Remove the pressure control hose from the control and interconnect with an inclined manometer as shown:



Reconnect wires VT-18 to Common and YL-11 to NO terminals.

With Power ON:

WARNING

LINE VOLTAGE NOW PRESENT.

4. Energize furnace for heating cycle. The induced draft blower motor will begin to run. The inclined manometer should read approximately 1.35" W.C. negative on small cabinets units and approximately 3.50" W.C. negative on large cabinets with no combustion. Refer to the Product Design section for pressure tap location.
5. Remove and check the two electrical wires and using the VOM check from Common to NO (Normally Open), it should read closed (with I.D. motor running). If not as above, replace control.
6. Reconnect all wires to the control and place in heating cycle.
7. As the unit fires, the inclined manometer negative pressure will drop to -.90" W.C. for the small cabinets and -1.90" W.C. for the large cabinets.
8. Begin to restrict the flue outlet until the pressure control trips, cycling OFF the burner. The control will trip at approximately 0.36" W.C.negative.
9. If not as listed, replace control.

Note: the pressure switch **must** be mounted with the diaphragm in a vertical position.

S-311 HIGH ALTITUDE APPLICATION

Package units covered by this manual are approved for use to 6,000 ft. in the USA. Canada (CSA) certified units are approved for use to 4,500 ft. High altitude kits provide for operation to 11,000 ft. in the USA. High altitude kits are not approved for use in Canada. It is not necessary to change the pressure switch for high altitude operation.

GAS	Kit Number	Altitude (Feet)	Orifice
NATURAL	HANG07	6001 - 11000	# 45
L. P. GAS	HALP09	6001 - 11000	# 56

S-312 CHECKING HOT SURFACE IGNITER

"Smart Valve" systems use a silicone carbide restrictive element ignitor is used for ignition. The normal operating temperature is approximately 2550°F. "DSI" systems use a spark type igniter.

WARNING

Disconnect Electrical Power Supply:

1. Ignitor cool - approximately 70 - 75°F.
2. Disconnect the ignitor from the Ignition Control Module and line voltage terminal board.
3. Using an ohmmeter measure the resistance of the ignitor it should read between 16 to 24 ohms for Norton mini ignitors. DSI system do not use hot surface ignitors.
4. Reconnect igniter.

With Power ON:

WARNING

VOLTAGE NOW PRESENT.

5. Place unit in heating cycle, measure current draw of ignitor during preheat cycle. Should read approximately 1 to 1.5 amps.

S-313 TESTING IGNITION CONTROL MODULE

NOTE: Failure to earth ground the unit, reversing the neutral and hot wire connection to the line (polarity), or a high resistance connection in the ground or neutral lines may cause the control to lockout due to failure to flame sense.

WARNING

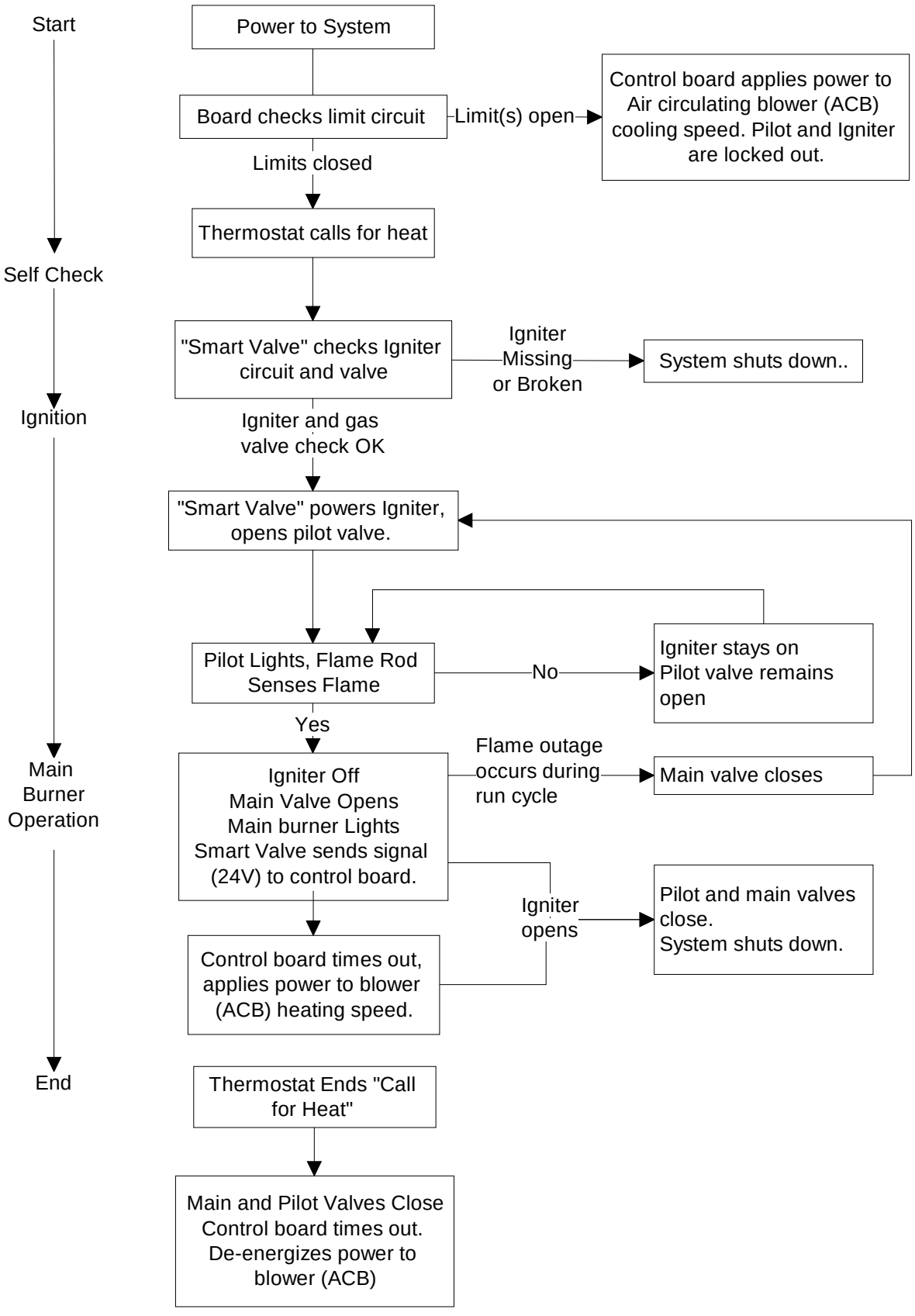
To avoid the risk of electrical shock, wiring to the unit must be properly polarized and grounded. Disconnect power before performing service.

The ground wire must run from the furnace all the way back to the electrical panel. Proper grounding can be confirmed by disconnecting the electrical power and measuring resistance between the neutral (white) connection and the burner closest to the flame sensor. Resistance should be less than 10 ohms.

Honeywell Smart Valve Ignition Systems

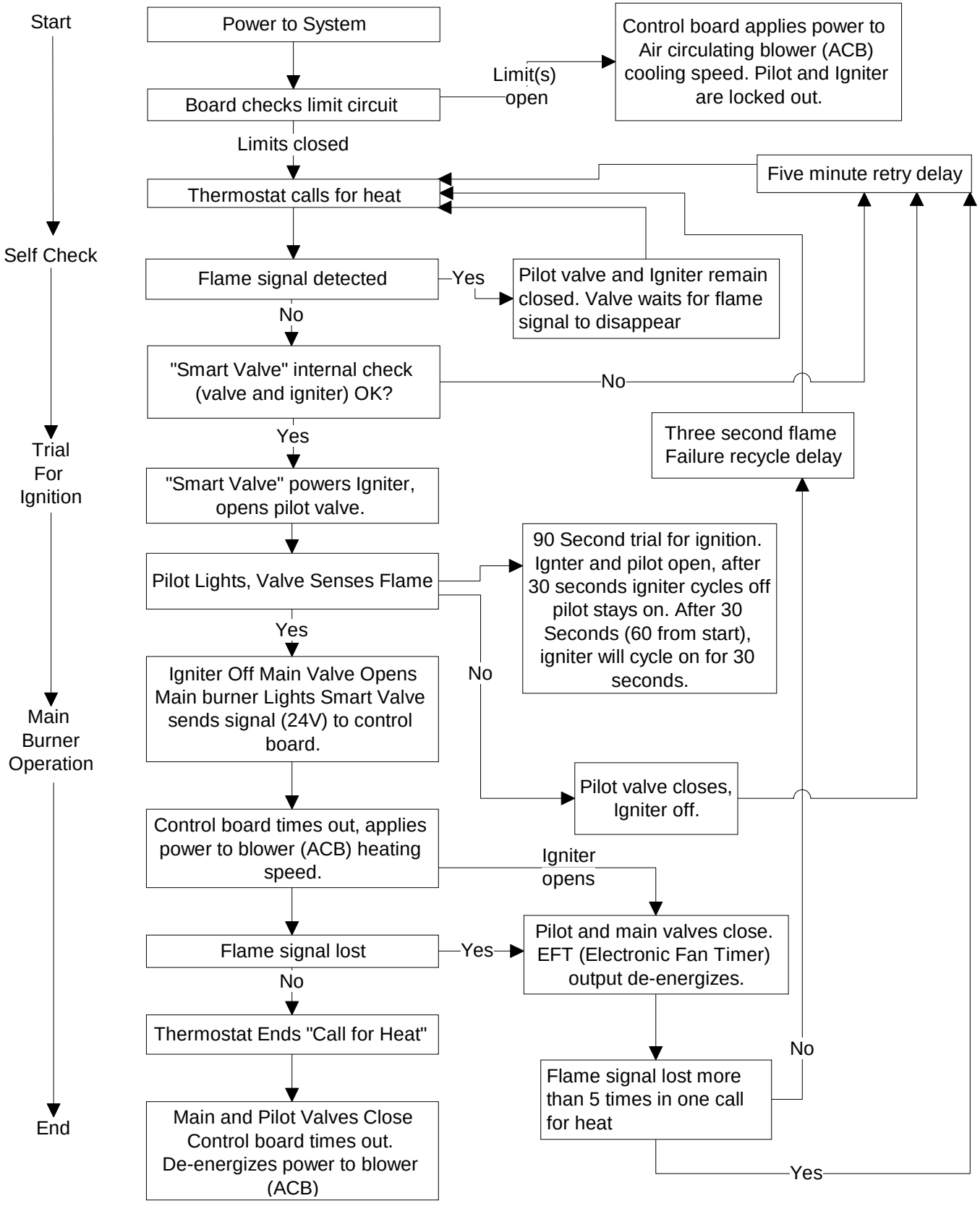
NORMAL SEQUENCE OF OPERATION (Honeywell Smart Valve System)

Honeywell Smart Valve Sequence of Operation
SV9500

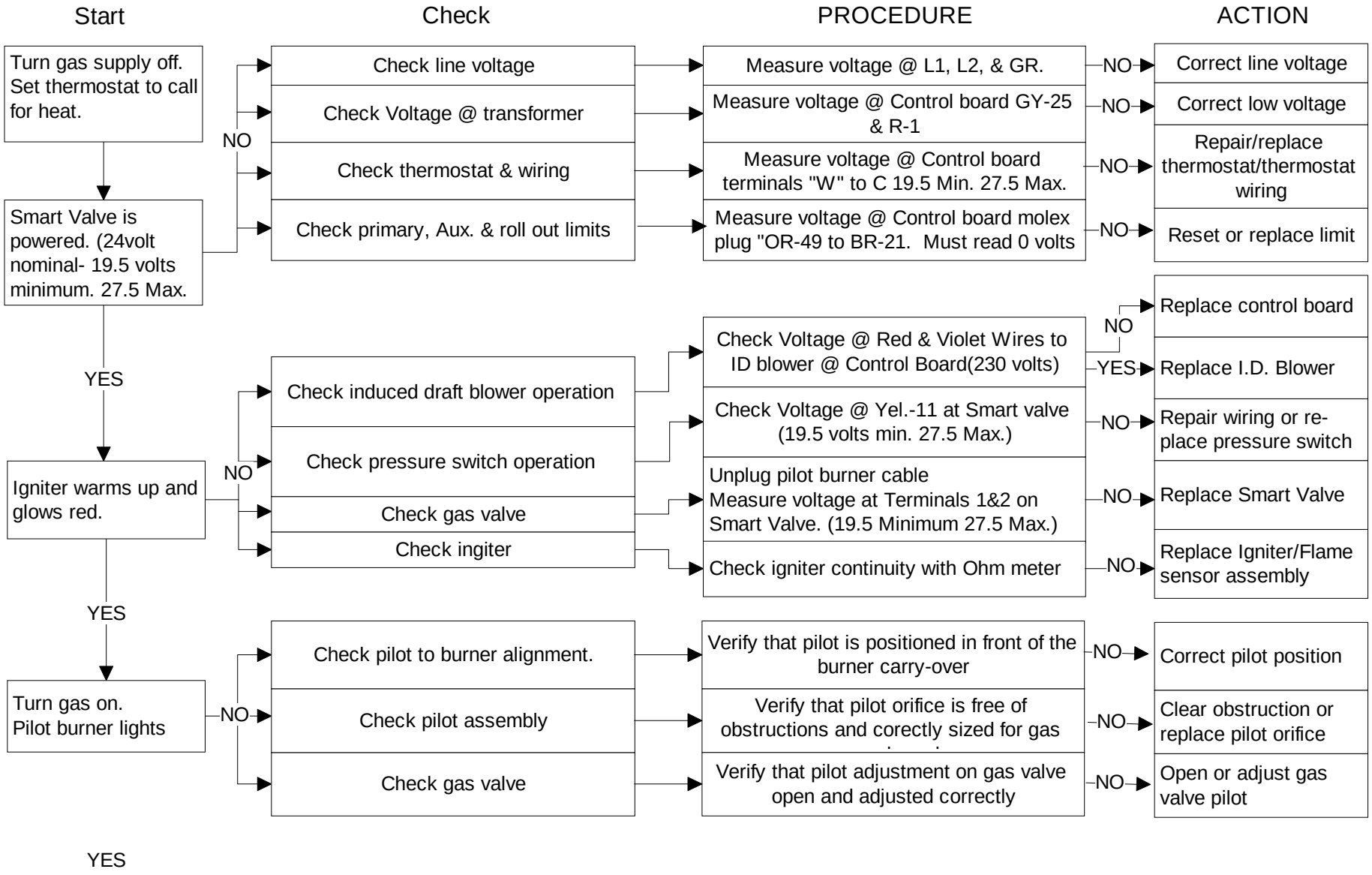

Start
Power to System
Board checks limit circuit
Limit(s) open
Control board applies power to Air circulating blower (ACB) cooling speed. Pilot and Igniter are locked out.
Limits closed
Thermostat calls for heat
Self Check
"Smart Valve" checks Igniter circuit and valve
Igniter Missing or Broken
System shuts down..
Ignition
Igniter and gas valve check OK
"Smart Valve" powers Igniter, opens pilot valve.
Pilot Lights, Flame Rod Senses Flame
No
Igniter stays on Pilot valve remains open
Yes
Flame outage occurs during run cycle
Main valve closes
Main Burner Operation
Igniter Off
Main Valve Opens
Main burner Lights
Smart Valve sends signal (24V) to control board.
Igniter opens
Pilot and main valves close.
System shuts down.
Control board times out, applies power to blower (ACB) heating speed.
End
Thermostat Ends "Call for Heat"
Main and Pilot Valves Close
Control board times out.
De-energizes power to blower (ACB)

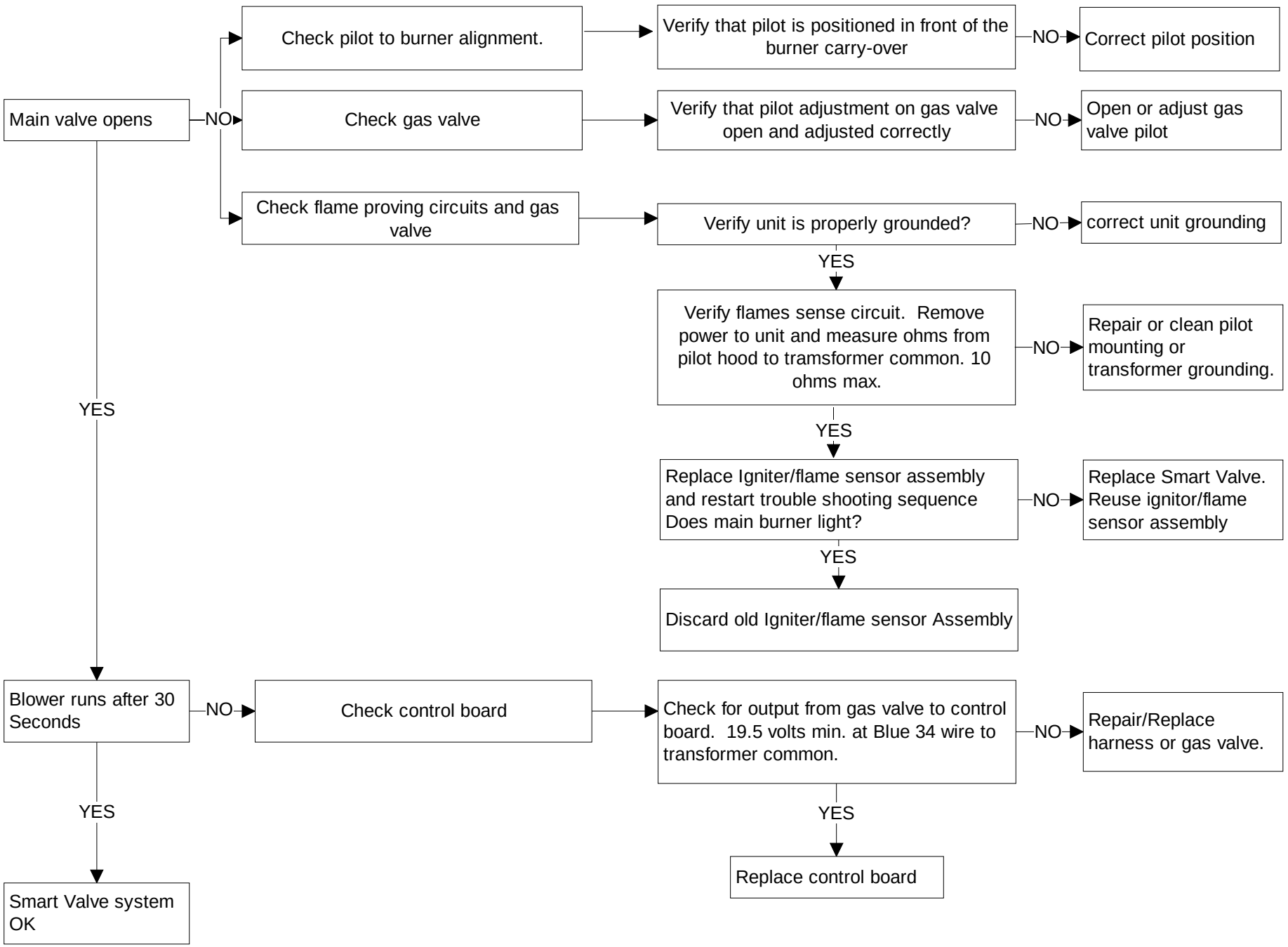
SERVICING

Honeywell Smart Valve Sequence of Operation
SV9501


Start
Power to System
Board checks limit circuit
Limit(s) open
Control board applies power to Air circulating blower (ACB) cooling speed. Pilot and Igniter are locked out.
Limits closed
Five minute retry delay
Thermostat calls for heat
Self Check
Flame signal detected
Yes
Pilot valve and Igniter remain closed. Valve waits for flame signal to disappear
No
"Smart Valve" internal check (valve and igniter) OK?
No
Three second flame Failure recycle delay
Yes
Trial For Ignition
"Smart Valve" powers Igniter, opens pilot valve.
Pilot Lights, Valve Senses Flame
90 Second trial for ignition. Ignter and pilot open, after 30 seconds igniter cycles off pilot stays on. After 30 Seconds (60 from start), igniter will cycle on for 30 seconds.
Yes
No
Igniter Off Main Valve Opens Main burner Lights Smart Valve sends signal (24V) to control board.
Main Burner Operation
Pilot valve closes, Igniter off.
Control board times out, applies power to blower (ACB) heating speed.
Igniter opens
Flame signal lost
Yes
Pilot and main valves close. EFT (Electronic Fan Timer) output de-energizes.
No
Thermostat Ends "Call for Heat"
No
Flame signal lost more than 5 times in one call for heat
End
Main and Pilot Valves Close Control board times out. De-energizes power to blower (ACB)
Yes

SMART VALVE DIAGNOSTIC / TROUBLE SHOOTING CHART


Start
Check
PROCEDURE
ACTION
Turn gas supply off. Set thermostat to call for heat.
Smart Valve is powered. (24volt nominal- 19.5 volts minimum. 27.5 Max.
YES
Igniter warms up and glows red.
YES
Turn gas on. Pilot burner lights
YES
NO
NO
NO
Check line voltage
Check Voltage @ transformer
Check thermostat & wiring
Check primary, Aux. & roll out limits
Measure voltage @ L1, L2, & GR.
Measure voltage @ Control board GY-25 & R-1
Measure voltage @ Control board terminals "W" to C 19.5 Min. 27.5 Max.
Measure voltage @ Control board molex plug "OR-49 to BR-21. Must read 0 volts
NO
NO
NO
NO
Correct line voltage
Correct low voltage
Repair/replace thermostat/thermostat wiring
Reset or replace limit
Check induced draft blower operation
Check pressure switch operation
Check gas valve
Check ingiter
Check Voltage @ Red & Violet Wires to ID blower @ Control Board(230 volts)
Check Voltage @ Yel.-11 at Smart valve (19.5 volts min. 27.5 Max.)
Unplug pilot burner cable Measure voltage at Terminals 1&2 on Smart Valve. (19.5 Minimum 27.5 Max.)
Check igniter continuity with Ohm meter
NO
YES
NO
NO
NO
Replace control board
Replace I.D. Blower
Repair wiring or re-place pressure switch
Replace Smart Valve
Replace Igniter/Flame sensor assembly
NO
Check pilot to burner alignment.
Check pilot assembly
Check gas valve
Verify that pilot is positioned in front of the burner carry-over
Verify that pilot orifice is free of obstructions and corectly sized for gas
Verify that pilot adjustment on gas valve open and adjusted correctly
NO
NO
NO
Correct pilot position
Clear obstruction or replace pilot orifice
Open or adjust gas valve pilot


Main valve opens
NO
Check pilot to burner alignment.
Verify that pilot is positioned in front of the burner carry-over
NO
Correct pilot position
Check gas valve
Verify that pilot adjustment on gas valve open and adjusted correctly
NO
Open or adjust gas valve pilot
Check flame proving circuits and gas valve
Verify unit is properly grounded?
NO
correct unit grounding
YES
Verify flames sense circuit. Remove power to unit and measure ohms from pilot hood to tramsformer common. 10 ohms max.
NO
Repair or clean pilot mounting or transformer grounding.
YES
YES
Replace Igniter/flame sensor assembly and restart trouble shooting sequence Does main burner light?
NO
Replace Smart Valve. Reuse ignitor/flame sensor assembly
YES
Discard old Igniter/flame sensor Assembly
YES
Blower runs after 30 Seconds
NO
Check control board
Check for output from gas valve to control board. 19.5 volts min. at Blue 34 wire to transformer common.
NO
Repair/Replace harness or gas valve.
YES
YES
Replace control board
Smart Valve system OK

SERVICING

Testing Honeywell Smart Valve Systems

The ignition control module is a combination electronic and electromechanical device and is not field repairable. Complete unit must be replaced.

With Power ON:

WARNING

LINE VOLTAGE NOW PRESENT.

Furnace thermostat calling for heat (4 to 5 second preheat time).

1. Check for 230 volts from L1 terminal of control module to L2. No voltage - check wire connections, continuity, etc.
2. Check for 24 volts at C" or X terminals on control board.
3. Voltage Present - check for voltage (24 VAC) between terminals 1 & 3 on gas valve (R-29 & GY-30). No voltage - replace Control board.

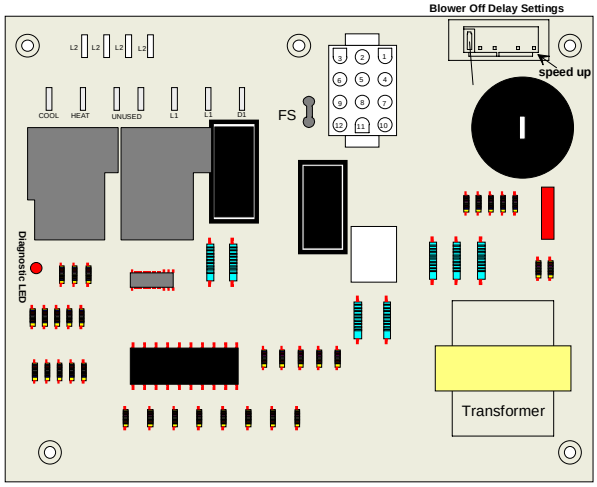
Note: Voltage to ignitor should read 24 volts.

4. Main burner will light only after pilot has proved flame. 30 seconds after main burner lights check for voltage between "heat" terminal and "neutral terminals" on board. No voltage - replace Control board.

DSI Direct Spark Ignition Systems

NORMAL SEQUENCE OF OPERATION (DSI Direct Spark Ignition System)

1. Thermostat calls for heat by energizing "W". The control checks the pressure switch for open condition. If the pressure switch is closed the control will flash code "3" and wait for the pressure switch to open.
2. The induced draft motor is energized and the control flashes code "2" and waits for the pressure switch to close. Once the pressure switch is closed, the LED stops flashing and the control begins timing the 15 second pre-purge.



DSI Control Board

3. The control energizes the spark igniter and gas valve for 7 seconds. If flame is established, the control goes into a 30 second heat on delay.
4. The indoor blower is energized at the heat speed after a 30 second on delay.
5. The control monitors the safety circuit inputs, flame, and thermostat during operation.
6. When the thermostat is satisfied, the gas valve is de-energized and the induced draft blower remains on for a 29 second post purge. The indoor blower remains on for the selected heat blower off delay (90, 120, or 150 seconds). Indoor blower off timing begins when thermostat call for heat ends.

Testing Direct Spark Ignition (DSI) systems

Furnace thermostat calling for heat (15 second prepurge time and 7 second trial for ignition).

1. Check for 230 volts from L1 terminal of control module to L2. No voltage - check wire connections, continuity, etc.
2. Check for 24 volts at "R to C" thermostat terminals. No voltage - check 3 amp automotive type fuse on control board. A blow fuse would indicate a short in the 24 volt circuit (thermostat or limit circuit).
3. Voltage Present - check for voltage (24 VAC) between terminals 1 & 3 on gas valve (R-29 & GY-30). No voltage - replace Control board.

Diagnostics Flash Codes

LED Steady On	Control is OK in standby, heat, cool, or fan only modes.
LED Steady Off	Internal control fault or no power.
1 Flash	Lockout due to failed ignition or flame dropouts.
2 Flashes	Pressure switch is open with induced draft motor energized.
3 Flashes	Pressure switch is stuck closed with induced draft motor de-energized.
4 Flashes	Limit switch is open (primary, auxiliary, or roll out).
5 Flashes	Flame detected with gas valve closed.
6 Flashes	Compressor output delayed from short cycle timer.
7 Flashes	Low flame sense current. Control will flash 7-times while continuing normal operation.
8 Flashes	Lock out due to five consecutive limit trips within a single call for heat. Resets in 1/2 hour.

NOTE: The flash rate is 0.25 seconds on, 0.25 seconds off, with a 2 second pause between codes.

SERVICING

S-314 CHECKING FLAME SENSOR

A flame sensing device is used in conjunction with the ignition control module to prove combustion. If a microamp signal is not present the control will de-energize the gas valve and "retry" for ignition or lockout.

The drawing right illustrates, the approximate distances for the pilot assembly to the gas inshot burner. You will note they are not in the main burner stream, but along the carry over ports.

Honeywell Smart Valve Systems

WARNING

Disconnect Electrical Power Supply:

1. The Honeywell "Flame Sense Measurement Kit", Amana part # R9900026, is required to correctly measure the microamp flame proving current.
2. Connect the Honeywell "Flame Sense Measurement Kit", Amana part # R9900026, as instructed in the kit instructions.

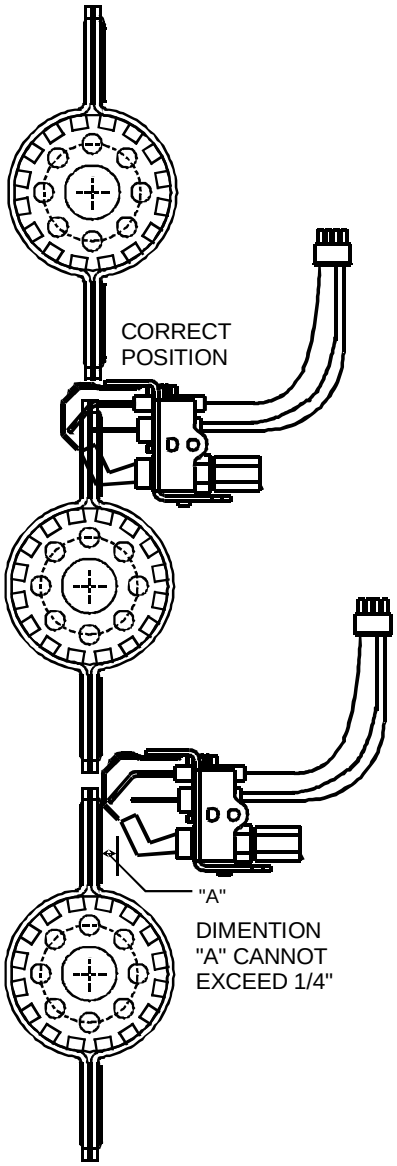
With Power ON:

WARNING

LINE VOLTAGE NOW PRESENT.

3. Place the unit into a heating cycle.
4. As soon as flame is established a microamp reading should be evident once proof of flame (microamp reading) is established, the hot surface ignitor will be de-energized.
5. The minimum microamp reading is 0.12 microamps for SV9500 valves and 1.40 microamps for SV9501 valves. If the microamp reading is less than the minimum specified, check for high resistance wiring connections, the distance between the sensor and burner, flame sensor connections or poor grounding.
6. If no reading, check for continuity on all components and if good - replace ignition control module.

NOTE: Contaminated fuel or combustion air can create a nearly invisible coating on the flame sensor. This coating works as an insulator causing a loss in the flame sense signal. If this situation occurs the flame sensor must be cleaned with emery cloth or steel wool. Do not use sand paper, the silicone in sand paper will further contaminate the sensor.



Burner Assembly

SERVICING

DSI Direct Spark Ignition Systems

WARNING

Disconnect Electrical Power Supply:

1. Disconnect the flame sensor wire from terminal FS of the ignition control module.
2. Connect a microamp meter in series with this wire and terminal FS.
3. Be sure the negative side of the meter is to the wire and the positive of the meter is to terminal FS.

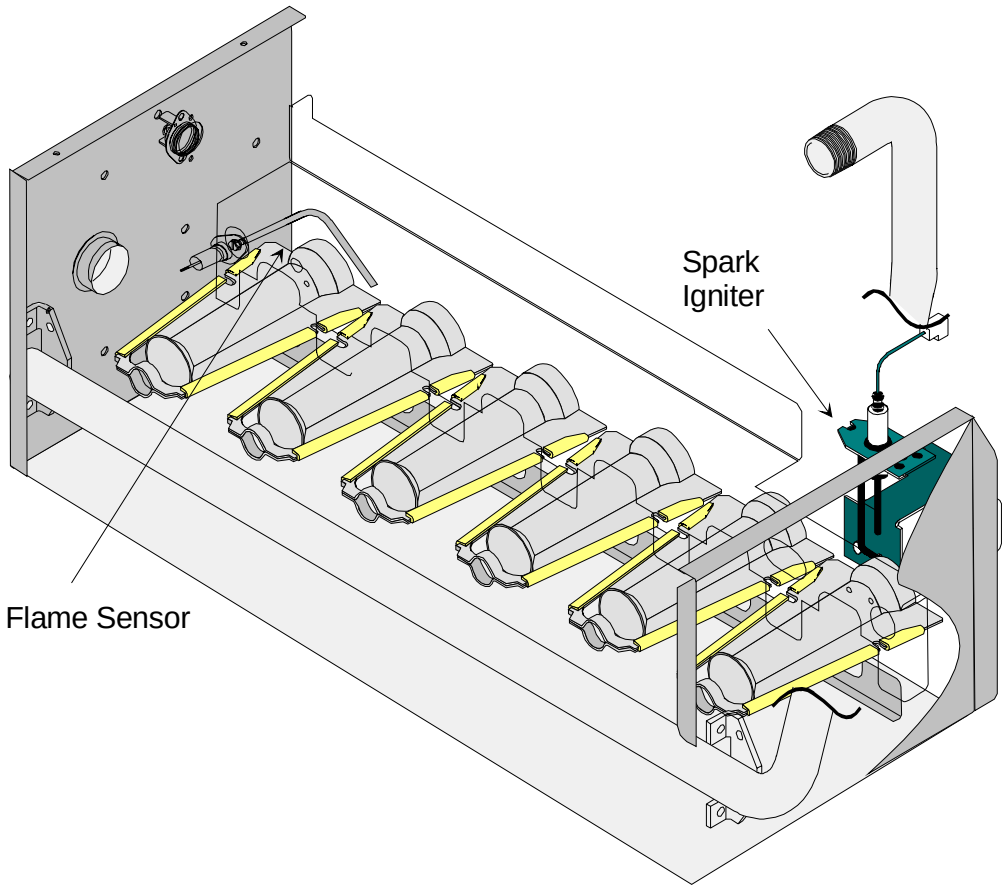
With Power ON:

WARNING

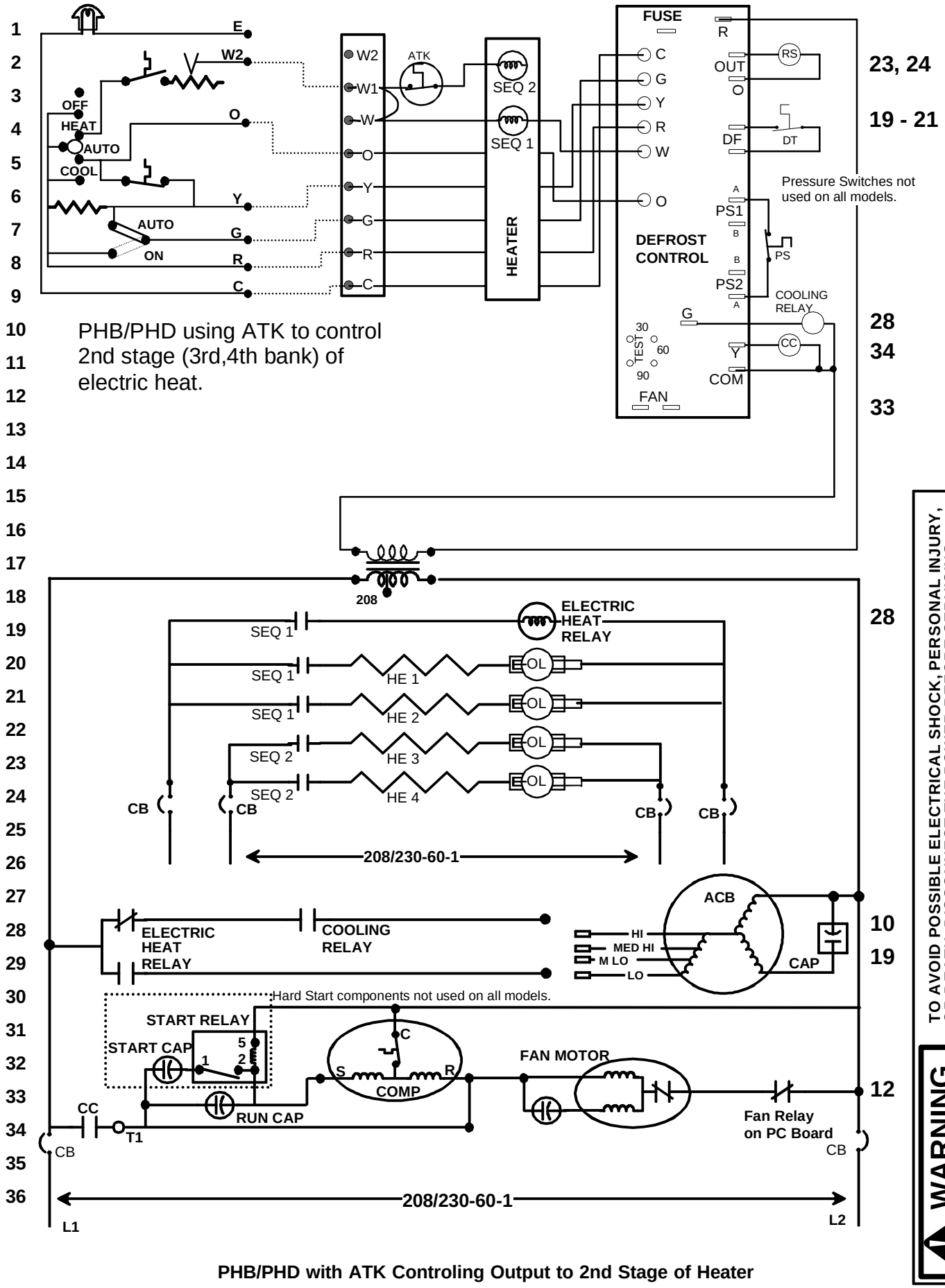
LINE VOLTAGE NOW PRESENT.

4. Place the unit into a heating cycle.
5. As soon as flame is established a microamp reading should be evident once proof of flame (microamp reading) is established, the hot surface ignitor will be de-energized.
6. The nominal microamp reading is 4 microamps.
7. If the microamp current is less than 1 microamp, the ignition control will flash a code of 7 flashes. If the microamp current is less than 0.4 microamps, the control will lockout and flash a code of 1 flash after attempting to restablish flame sense.
8. If the microamp reading is less than the minimum specified, check for high resistance wiring connections, the distance (3/16") between the sensor and burner, flame sensor connections or poor grounding.
9. If no reading, check for continuity on all components and if good - replace ignition control module.

NOTE: Contaminated fuel or combustion air can create a nearly invisible coating on the flame sensor. This coating works as an insulator causing a loss in the flame sense signal. If this situation occurs the flame sensor must be cleaned with emery cloth or steel wool. Do not use sand paper, the silicone in sand paper will further contaminate the sensor.



WIRING DIAGRAMS

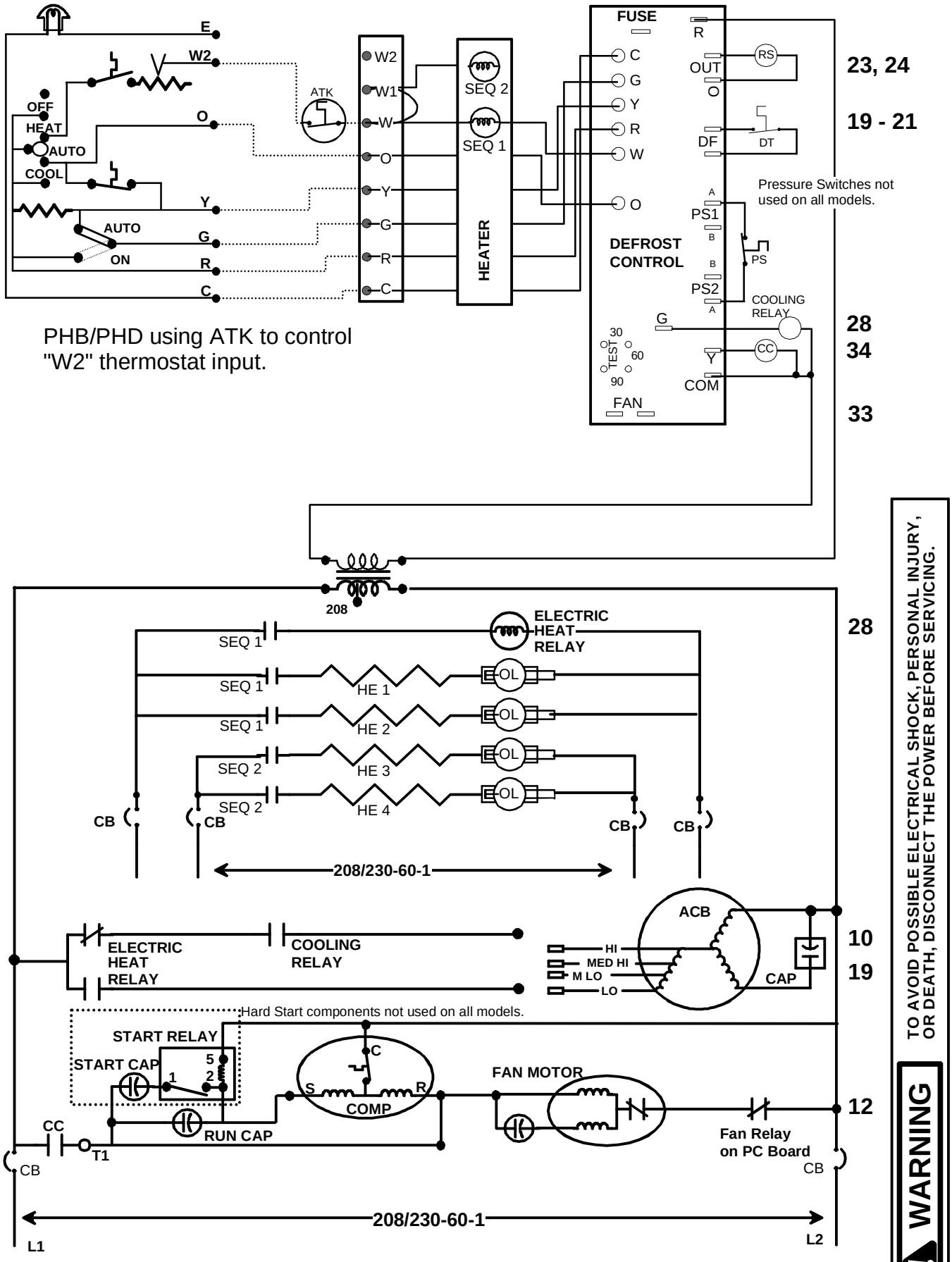


PHB/PHD with ATK Controling Output to 2nd Stage of Heater

TO AVOID POSSIBLE ELECTRICAL SHOCK, PERSONAL INJURY, OR DEATH, DISCONNECT THE POWER BEFORE SERVICING.

WARNING

WIRING DIAGRAMS

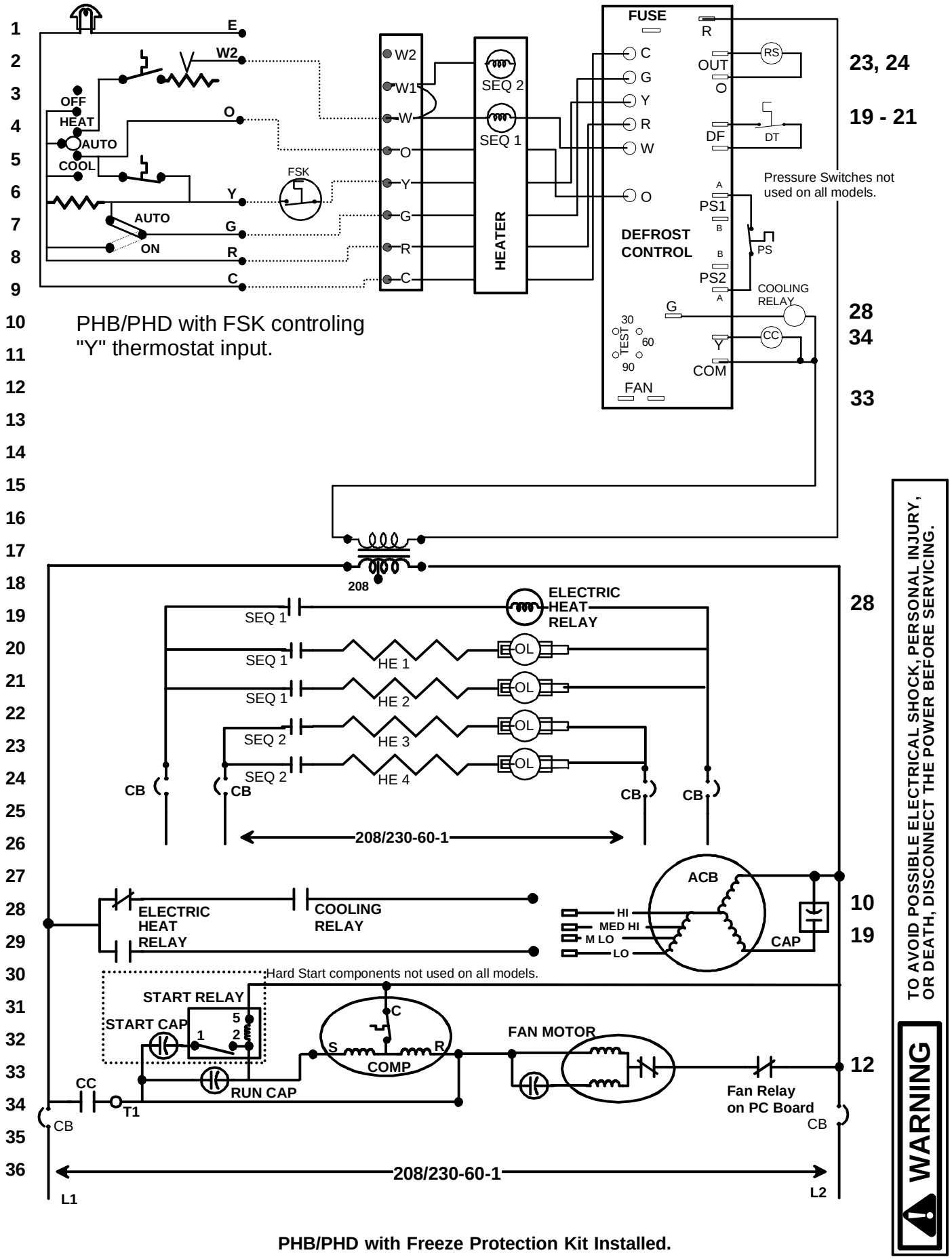


PHB/PHD with ATK Controling 2nd Stage Thermostat Input

WARNING

TO AVOID POSSIBLE ELECTRICAL SHOCK, PERSONAL INJURY, OR DEATH, DISCONNECT THE POWER BEFORE SERVICING.

WIRING DIAGRAMS

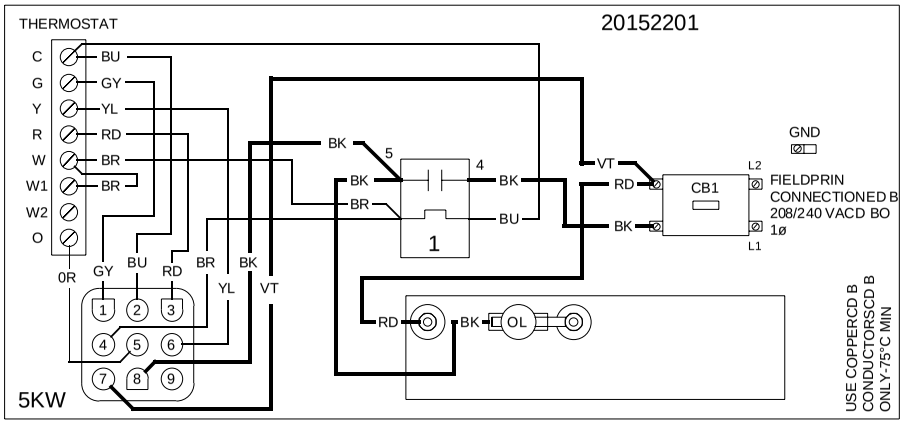


PHB/PHD with Freeze Protection Kit Installed.

WARNING

TO AVOID POSSIBLE ELECTRICAL SHOCK, PERSONAL INJURY, OR DEATH, DISCONNECT THE POWER BEFORE SERVICING.

WIRING DIAGRAMS



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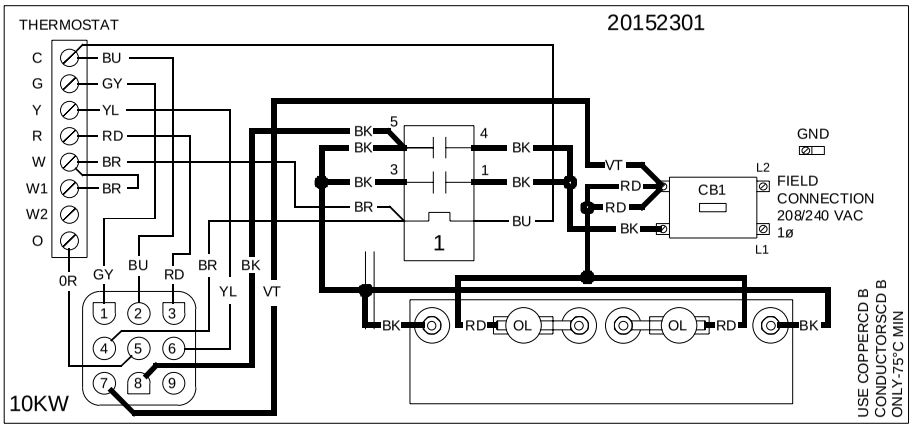

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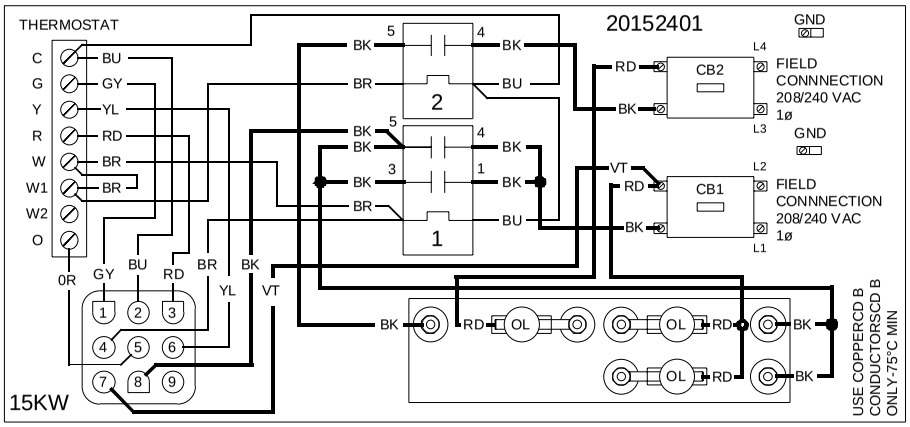

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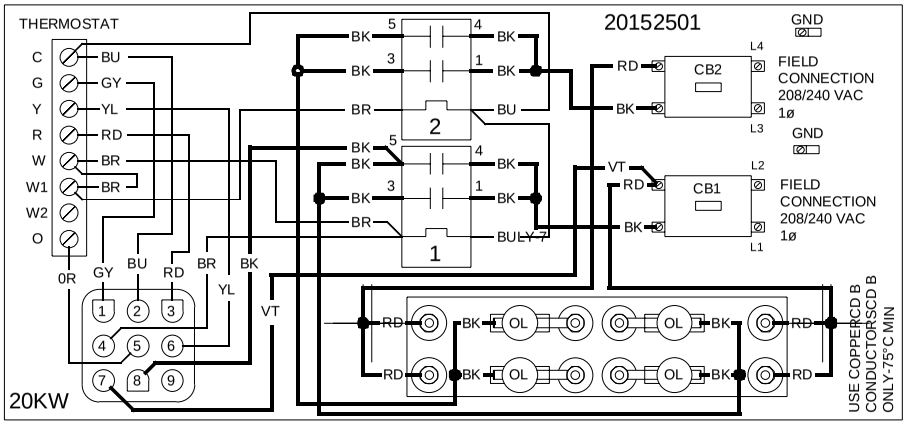

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WARNING

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